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Soil Survey of Designated Areas within Kananaskis Provincial Park, Alberta and Interpretation for Recreational Use

by

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PREFACE

This report, one of a series describing detailed and semi-detailed soil surveys of provincial parks and recreation areas in Alberta, is a follow-up to a report written in 1976 for the Kananaskis Lakes area (Greenlee, 1976). This report describes soil surveys of four separate, designated areas within Kananaskis Provincial Park, covered in the initial report, but conducted again in more detail during the summer of 1977. The total mapped area in 1975 was about 3500 ha, and in 1977 was about 895 ha.

An explanatory section at the beginning of the initial report, as well as the Glossary and much of the text are not repeated in this report. Specific results and interpretations for the areas covered in this version are presented in the sections entitled "Soils," "Miscellaneous Land Types," and "Soil Interpretations."

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SUMMARY

The mapped areas are about 56 km west of Calgary, along TransCanada Highway Number 1, and about 48 km south along Highway Number 40 (Fig. 1). The four areas mapped total about 895 ha of mountainous terrain, adjacent to the shores of Upper and Lower Kananaskis Lakes. Gravelly, cobbly, moderately coarse to medium-textured morainal deposits predominate throughout most of the study areas. A few deposits of very coarse-textured glaciofluvial sediments, or gravel, also occur. Numerous, thin, organic deposits are found, as well. The climate is highly variable, with long cold winters interrupted occasionally by warm chinook winds. The vegetation ranges from subalpine coniferous forests at the lower elevations to alpine tundra above the tree line; the dominant tree-cover is lodgepole pine.

Eight map units were recognized during the mapping program of 1975, and 13 more during 1977. Of this total of 21, nineteen were mapped during 1977. The key profile types are Brunisolic Gray Luvisols; Orthic Gray Luvisols; Orthic and Eluviated Eutric Brunisols; Gleyed Eutric Brunisols; Orthic Melanic Brunisols; Orthic and Gleyed Regosols; Rego, Orthic, Orthic Luvic and Orthic Humic Gleysols; Mesisols and Terric Mesisols; and Humisols and Terric Humisols. These soil types are distributed over the landscape in relation to landform, parent material, and drainage. Map units consist of single soil series, groupings of series or catenas; their distribution is shown on the soil map.

Soil interpretations are made for each map unit for primitive camping areas, fully serviced campgrounds, picnic areas, paths, trails, lawns and landscaping, buildings with basements, buildings without basements, septic tank absorption fields, trench-type sanitary landfills, road location, source of roadfill and source of sand or gravel.

When found on favorable topography, the soils of map units 1, 2, 3, 4, 7, 8, 10, 11, 12 and 15 are most suited for recreational development. All the soils, however, have moderate to severe limitations for specific uses. Many soils have severe limitations in numerous locations because of steep slopes resulting in soil erosion hazards. Soils of map unit 12 are probably best suited overall for recreational uses in the mapped area. Soils of map units 1, 2, 4, 12 and 15 are the most favorable for building sites and road construction, when found on suitable topography. Careful study of the soil map and Tables 6 to 18, which are the soil limitation and suitability tables, will reveal areas suitable for particular uses.

Properly interpreted, a soil survey can be a very useful tool for the proper design of a recreational area. Since all soil differences that occur in the field cannot be shown on the soil map, design and construction of specific recreational facilities usually require on-site investigation.

INTRODUCTION

LOCATION AND SIZE

The mapped areas are located west of Calgary, about 56 km along TransCanada Highway Number 1, and then about 48 km south along Highway Number 40 (Fig. 1). The four areas mapped total about 895 ha of mountainous terrain adjacent to the shores of Upper and Lower Kananaskis Lakes. The northernmost area (area one), about 290 ha around the northern tip of the lower lake, includes portions of sections 11 through 14, township 20, range 9, west of the fifth meridian. Area two, about 1.7 km south of area one on the eastern side of the lower lake, borders the meltwater channel of Muskeg Creek along its eastern side. This area is about 145 ha and includes portions of section 31, township 19, range 8; section 36, township 19, range 9; and section 1, township 20, range 9; all west of the fifth meridian. Area three is further south, in the Boulton Creek fan on the eastern side of the lower lake. Area three (215 ha) includes portions of sections 19 and 30, township 19, range 8; and sections 24 and 25, township 19, range 9; west of the fifth meridian. Area four is between the upper and lower lakes, as well as about 2 km northward along the northwestern shore of the lower lake. This area is about 245 ha and includes portions of sections 13, 23, 24, and 26, township 19, range 9, west of the fifth meridian.

CHEMICAL AND PHYSICAL ANALYSES

Chemical and physical analyses carried out in the Alberta Institute of Pedology laboratories on horizon samples of representative soil profiles from the surveyed areas determined:

1. *Soil Reaction*: pH was determined with a Beckman model Zeromatic pH meter equipped with a glass and calomel electrode. The pH in $CaCl_2$ was determined using a 2:1 0.01 M $CaCl_2$ solution to soil ratio (Peech, 1965), and the pH in water was determined on a saturated soil paste (Doughty, 1941).

2. *Exchangeable Cations and Cation Exchange Capacity*: the cation exchange capacity was determined by displacement of ammonium with sodium chloride (Chapman, 1965). Exchangeable cations were extracted by the A.O.A.C. (1955) method and Na, K, Ca, and Mg were determined by atomic absorption spectrophotometry.

3. *Organic Carbon* (Allison *et al.*, 1965): organic carbon was determined by dry combustion using an induction furnace with a gasometric detection of evolved CO_2 (Leco Carbon Analyzer Model 557-100).

4. *Calcium Carbonate Equivalent*: the calcium carbonate equivalent was determined by the inorganic carbon manometric method of Bascomb (1961).

5. *Mechanical Analysis*: the mechanical analysis was carried out by the pipette method of Kilmer and Alexander, as modified by Toogood and Peters (1953).

6. *Free Iron and Aluminum*: free iron and aluminum were extracted with sodium pyrophosphate by the McKeague (1967) method; the determination of Fe and Al was done by atomic absorption spectroscopy.

PHYSIOGRAPHY AND SURFICIAL DEPOSITS

Greenlee (1976) described the physiography and surficial deposits in the initial report. Gravelly, cobbly, moderately coarse- to medium-textured morainal deposits predominate throughout most of areas one, two, and four. In area one, a few deposits of very coarse-textured glaciofluvial sediments, or gravel, occur immediately adjacent to the northern and northwestern shores of the lower lake. These types of deposits are also found in area four, bordering the southern shore of the lower lake.

In area one, a thin veneer of medium- to moderately coarse-textured fluvial sediments overlying gravel has been deposited on the delta of the Smith-Dorrien Creek bordering the northwestern shore of the lower lake, and in the floodplain of Pocaterra Creek near the northeastern boundary of this area. An island of medium- to moderately fine-textured, nearly stone-free till is situated between Pocaterra Creek and the paralleling meltwater channel to the west. A small inclusion of medium-textured till, that is somewhat less stony than most in this region, is also found at the southeastern corner of area one.

In area three, near the Boulton Creek fan, the predominant surficial deposit is gravelly, cobbly medium- to moderately coarse-textured till, although numerous very coarse-textured glaciofluvial deposits, or gravel, are also found. Exceptions are the floodplain and fan of Boulton Creek, where a thin veneer of medium- to moderately coarse-textured fluvial sediments overlie gravel. Numerous thin organic deposits are found in area three, in glacial meltwater channels and a few other depressional locations. These deposits are also found in scattered depressions in areas one, two, and four. Some are fairly extensive.

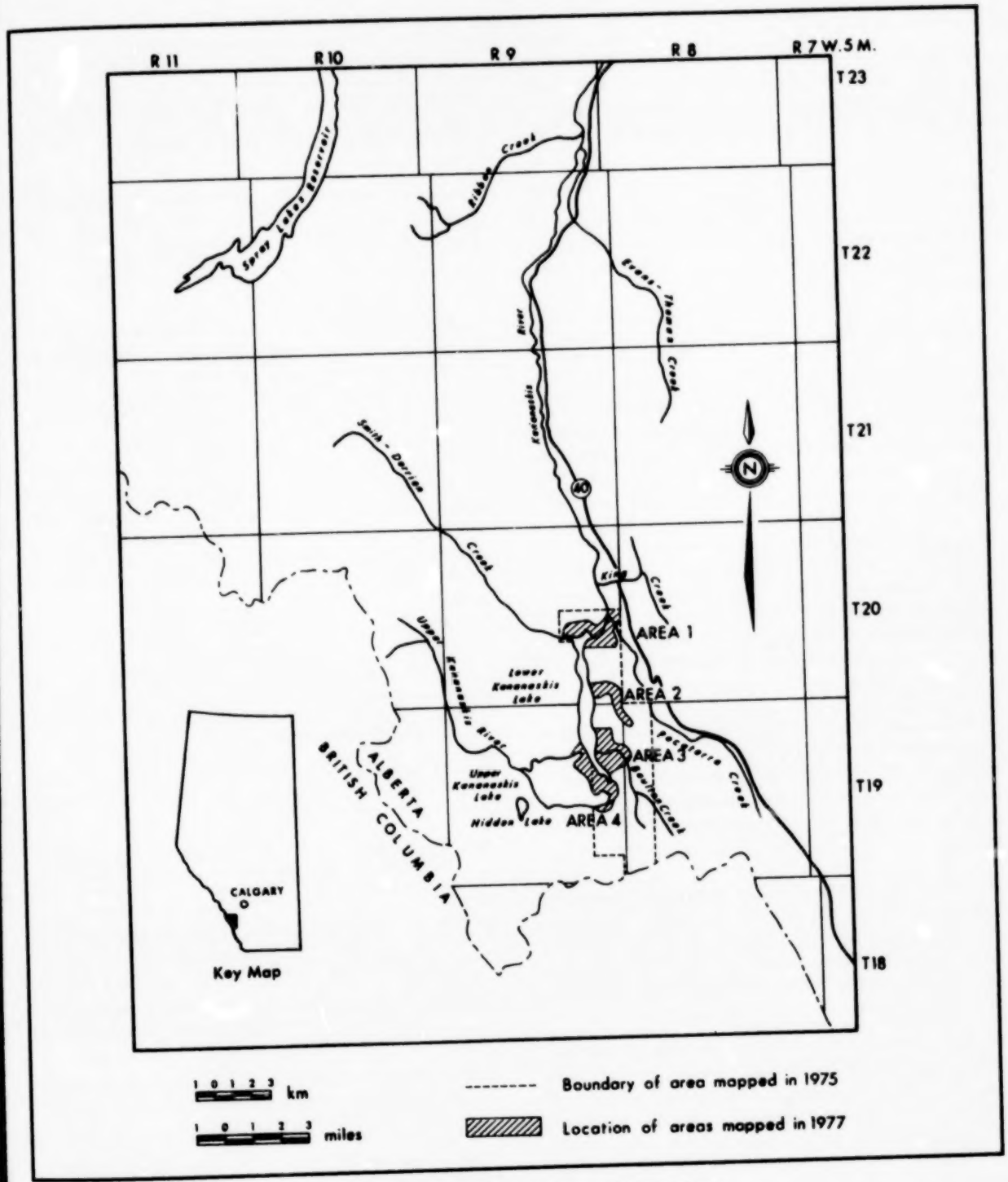

FIGURE 1. Map Showing Locations of Mapped Areas.

CLIMATE AND VEGETATION

Greenlee (1976) described both climate and vegetation in the initial report. Two plant species not listed in the 1976 report, and observed in the 1977 soil survey, are silverweed (*Potentilla anserina*) and sedge (*Carex* spp.).

SOILS

Soils were classified according to the Canadian System of Soil Classification (see Appendix A and Canada Soil Survey Committee, 1978). On the soil map each unit is represented by a symbol.

$$\text{topographic class (Table 1)} + \frac{4}{e3} + \begin{matrix}\text{map unit}\\ \text{surface stoniness rating (Table 2)}\end{matrix}$$

The map units may be single soil series, groupings of series, or catenas. A soil series consists of soils that are essentially alike in all major profile characteristics except in the texture of the surface (Canada Department of Agriculture, 1976). Within a map unit of a grouping of series, the series are found together in a characteristic pattern in the landscape, and outlining each separately at the scale of mapping used is unfeasible. A catena is simply a sequence of soils of about the same age, derived from similar parent materials, and found under similar climatic conditions and in characteristic patterns, that have unlike characteristics because of variations in relief and drainage (Canada Department of Agriculture, 1976).

If a map unit has a single series, other soil series may be found nearby. The dominant series is roughly 70 to 90 percent of the map unit; the other series are present in such minor amounts that they are not significant enough to affect the use of that particular map unit for a specific purpose.

Where a map unit consists of a grouping of series, the different series generally possess very similar properties. The approximate percentage of each series is indicated in the soil report. Minor insignificant inclusions of other series may be present but are not mentioned in the definition of the map unit.

If a map unit consists of a catena, the approximate percentages of only the dominant members, which could also be series, are indicated. Insignificant amounts of other members are often present, but are not mentioned. Soil interpretations are for the most dominant member of a catena, and interpretations for the less dominant members may, or may not be, different.

TABLE 1
Topographic Classes and Symbols
(Canada Department of Agriculture, 1974)

Simple Topography Single Slopes (regular surface)		Complex Topography Multiple Slopes (irregular surface)		Slope %	
A	depressional to level	a	nearly level	0	to 0.5
B	very gently sloping	b	gently undulating	>0.5	to 2
C	gently sloping	c	undulating	>2	to 5
D	moderately sloping	d	gently rolling	>5	to 9
E	strongly sloping	e	moderately rolling	>9	to 15
F	steeply sloping	f	strongly rolling	>15	to 30
G	very steeply sloping	g	hilly	>30	to 60
H	extremely sloping	h	very hilly		over 60

Eight map units were recognized in the area mapped during 1975; 13 more were recognized during 1977. Of this total of 21, nineteen were mapped during 1977, and are described in this report. Six map units described in the initial report are repeated here. Of the 19, the soils of five are classified in the Luvisolic Order; the soils of each of four are classified in the Gleysolic and Organic Orders; and the soils of each of two are classified in the Brunisolic and Regosolic Orders. Also, the soils of two map units are each divided randomly between the Brunisolic and Regosolic Orders. Table 3 outlines pertinent features of the map units.

TABLE 2
Surface Stoniness Ratings[1]
(Canada Soil Survey Committee, 1978)

Stony 0 - (non-stony phase) – very few stones (≤0.01% of surface, stones > 30 m apart)

Stony 1 - (slightly stony phase) – some stones that hinder cultivation slightly or not at all (0.01 to 0.1% of surface, stones 10 to 30 m apart)

Stony 2 - (moderately stony phase) – enough stones to cause some interference with cultivation (0.1 to 3% of surface, stones 2 to 10 m apart)

Stony 3 - (very stony phase) – sufficient stones to handicap cultivation seriously; some clearing is required (3 to 15% of surface, stones 1 to 2 m apart)

Stony 4 - (exceedingly stony phase) – sufficient stones to prevent cultivation until considerable clearing is done (15 to 50% of surface, stones 0.1 to 0.5 m apart)

Stony 5 - (excessively stony phase) – too stony to permit cultivation; boulder or stone pavement (≥50% of surface, stones <0.1 m apart)

[1] Phases of stoniness are defined on the basis of the percentage of the land surface occupied by fragments coarser than 15 cm in diameter.

TABLE 3
Key to the Soils

Map Unit	Classification	Parent Material	Surface Texture	Slope (class and gradient)	Surface Stoniness	Drainage	Comments and Limitations
1	Brunisolic Gray Luvisol	moderately coarse-textured, gravelly, cobbly till - 70% gravel - 30%	SiL	b,C,c, D,d,e,f, g (>=0.5 to 60%)	2 to 4	well drained	Thin L-H horizons – very erodible. Slight to moderate limitations, good source of roadfill, poor source of gravel – surface stoniness, slippery or sticky when wet, lack of Ah horizon, excessive slope, erosion hazard.
2	Orthic and Eluviated Eutric Brunisol	medium- to very coarse-textured gravelly, cobbly till	SiL to VFSL	c,d,f, G,g (>=2 to 60%)	3 to 5	well to rapidly drained	Dry, south-facing slopes severely eroded. Slight to severe limitations, good source of roadfill, fair source of gravel – surface stoniness, excessive slope, erosion hazard, slippery or sticky when wet, lack of Ah horizon, high lime content, rapid permeability, groundwater contamination hazard.
3	Orthic Eutric Brunisol and Orthic Regosol	medium- to very coarse-textured fluvial sediments overlying gravel	SiL, L, FSL	b,c (>=0.5 to 5%)	0 to 3	well drained	Depth to gravel commonly 25 to 60 cm. Moderate to severe limitations poor source of roadfill, fair source of gravel – flooding hazard, slippery or sticky when wet, lack of Ah horizon, high lime content, susceptibility to frost heave, moderate shrink-swell potential, rapid permeability, groundwater contamination hazard, surface stoniness.
4	Brunisolic Gray Luvisol	medium- to moderately coarse-textured gravelly cobbly till	SiL	C,c,d, E,e,F,f, G,g (>=2 to 60%)	2 to 5	well drained	Thin L-H horizons – very erodible. Slight to moderate limitations, good source of roadfill, poor source of gravel – surface stoniness, slippery or sticky when wet, excessive slope, erosion hazard, lack of Ah horizon.
5-6							Not mapped in 1977.
7	Brunisolic Gray Luvisol	medium- to moderately fine-textured till containing a high proportion of weathered shale	SiL	f (>=15 to 30%)	0 and 1	well drained	Moderate to severe limitations, poor source of roadfill, unsuitable as a source of sand or gravel – excessive slope, erosion hazard, slippery or sticky when wet, lack of Ah horizon, susceptibility to frost heave, moderate shrink-swell potential.
8	Orthic Regosol	medium- to moderately fine-textured fluvial sediments overlying gravel	SiL	B,C,e (>=0.5 to 5% and >9 to 15%)	0	well drained	Moderate to severe limitations, poor source of roadfill and gravel – flooding hazard, slippery or sticky when wet, susceptibility to frost heave, moderate shrink-swell potential, rapid permeability. groundwater contamination hazard, lack of Ah horizon, high lime content, excessive slope, erosion hazard.

TABLE 3.
Key to the Soils (continued)

Map Unit	Classification	Parent Material	Surface Texture	Slope (class and gradient)	Surface Stoniness	Drainage	Comments and Limitations
9	Rego and Orthic Gleysol	medium- to very coarse-textured fluvial sediments overlying gravel	L to LS	a, b (0 to 2%)	0	poorly drained	Water table occasionally within 30 cm of surface. Severe limitations, poor source of roadfill and gravel – seasonally high groundwater table, flooding hazard, lack of Ah horizon, groundwater contamination hazard.
10	Orthic Regosol	gravel	gravel	b (>=0.5 to 2%)	4 and 5	very rapidly drained	Moderate to severe limitations, good source of roadfill, poor source of gravel – surface stoniness, flooding hazard, lack of Ah horizon, high lime content, rapid permeability, groundwater contamination hazard.
11	Gleyed Regosol and Gleyed Eutric Brunisol	medium-textured fluvial sediments overlying gravel	SiL to L	b, c (>=0.5 to 5%)	0 and 1	imperfectly drained	Occasional sand lenses occur, depth to gravel 25 to 100 cm, water table sometimes within 75 cm of surface. Moderate to severe limitations, poor source of roadfill and gravel – flooding hazard, seasonally high groundwater table, slippery or sticky when wet, susceptibility to frost heave, moderate shrink-swell potential, groundwater contamination hazard, lack of Ah horizon, high lime content.
12	Orthic Gray Luvisol	medium- to moderately coarse-textured glacio-fluvial sediments overlying gravel	SiL	c (>=2 to 5%)	0 and 1	well drained	Depth to gravel 25 to 100 cm. Slight to severe limitations, poor source of roadfill, good source of gravel – slippery or sticky when wet, susceptibility to frost heave, moderate shrink-swell potential, rapid permeability, groundwater contamination hazard, lack of Ah horizon.
13	Orthic Gleysol and Orthic Luvic Gleysol (peaty and non-peaty phases)	moderately coarse-textured to moderately fine-textured till	SiL to CL	a,B,b, C,c,d, e,F (0 to 30%)	0 to 4	poorly drained	Where micro peat hummocks occur, Of and Om horizons are the main components. Severe limitations, poor source of roadfill, unsuitable as a source of sand or gravel – seasonally high groundwater table, slippery or sticky when wet, organic surface layer>=15 cm thick, susceptibility to frost heave, moderate shrink-swell potential, lack of Ah horizon, excessive slope, erosion hazard, surface stoniness.
14	Orthic Humic Gleysol	medium- to moderately fine-textured till containing a high proportion of weathered shale	SiL	a (0 to 0.5%)	0	poorly drained	Severe limitations, poor source of roadfill, unsuitable as a source of sand or gravel – seasonally high groundwater table, slippery or sticky when wet, susceptibility to frost heave, moderate shrink-swell potential, groundwater contamination hazard.

TABLE 3
Key to the Soils (continued)

Map Unit	Classification	Parent Material	Surface Texture	Slope (class and gradient)	Surface Stoniness	Drainage	Comments and Limitations
15	Orthic Melanic Brunisol	medium-textured stony till	SiL	e (>9 to 15%)	3	well drained	Slight to severe limitations, poor source of roadfill, unsuitable as a source of sand or gravel — excessive slope, erosion hazard, slippery or sticky when wet, susceptibility to frost heave, moderate shrink-swell potential, surface stoniness.
16	Orthic Humic Gleysol	medium- to moderately fine-textured stony till	L to VFSL	c (>2 to 5%) /	3	poorly drained	Severe limitations, poor source of roadfill, unsuitable as a source of sand or gravel — seasonally high groundwater table, slippery or sticky when wet, susceptibility to frost heave, moderate shrink-swell potential, groundwater contamination hazard, surface stoniness.
M	Mesisol	predominantly intermediately decomposed peat	peat	a, E (0 to 0.5% and >9 to 15%)	0	very poorly drained	Severe limitations, unsuitable for many uses - organic soil, seasonally high groundwater table, high shrink-swell potential, susceptibility to frost heave, groundwater contamination hazard, lack of Ah horizon, excessive slope.
TM	Terric Mesisol	predominantly intermediately decomposed peat overlying undifferentiated mineral material	peat	C (>2 to 5%)	0	very poorly drained	Severe limitations, unsuitable for many uses - organic soil, seasonally high groundwater table, high shrink-swell potential, susceptibility to frost heave, groundwater contamination hazard, lack of Ah horizon.
H	Humisol	predominantly highly decomposed peat	peat	a, C (0 to 0.5% and >2 to 5%)	0	very poorly drained	Severe limitations, unsuitable for many uses - organic soil, seasonally high groundwater table, high shrink-swell potential, susceptibility to frost heave, groundwater contamination hazard, lack of Ah horizon.
TH	Terric Humisol	predominantly highly decomposed peat overlying undifferentiated mineral material	peat	a,b,C, D,E,F, (0 to 30%)	0	very poorly drained	Terric Humisol areas commonly bordered by escarpments. Severe limitations, unsuitable for many uses - organic soil, seasonally high groundwater table, high shrink-swell potential, susceptibility to frost heave, groundwater contamination hazard, lack of Ah horizon, excessive slope.

In general, the most common and widespread soils found throughout the forested regions of Alberta are those of the Luvisolic Order, and the mapped area is no exception. These are well- to imperfectly drained soils characterized by an Ae horizon near the surface, which generally varies in thickness from 7.5 to 30 cm, is a leached gray color, and contains very little organic matter (humus) and plant nutrients. Luvisolic soils in their natural state commonly have surface L-H and Ah horizons as well. The uppermost L-H horizon consists primarily of leaves, twigs, and woody

materials, with a minor component of mosses, in various stages of decomposition, and ranges in thickness from 2.5 to 12.5 cm or more. The Ah horizon below this is humus-rich and high in plant nutrients, but is usually less than 5 cm thick, and in Luvisolic soils is often absent altogether. This horizon is commonly referred to as "topsoil" and is much thicker in prairie or grassland soils. When Luvisolic soils are cultivated, the L-H and Ah horizons quickly become mixed with the Ae horizon, resulting in grayish-colored fields.

The L-H and Ah horizons break down rapidly under heavy foot traffic in recreation areas, or often disappear completely under a combination of physical destruction and erosion. The Ae horizon often dries out and becomes baked and hard, so plant seedlings find it difficult, if not impossible, to push up through the crust. Not only does the hard crust hamper new growth, it also repels water so that rainfall will run off quickly, causing soil erosion, especially on steep slopes.

Well-drained Luvisolic soils are dominant throughout the upland portions of the four mapped areas.

Soils of the Brunisolic order are well- to imperfectly drained mineral soils. They have sufficient profile development to exclude them from the Regosolic order, but they lack the kinds of horizon development specified for soils of other orders. A common characteristic is the development in situ of a prominent brownish Bm horizon with sufficient alteration by hydrolysis, oxidation, or solution to produce significant changes in color, structure, and composition different from those of an A or C horizon. The processes of leaching and weathering are relatively weakly developed in Brunisolic soils, so the soils tend to reflect the chemical characteristics, particularly the base status and acidity, of their parent materials.

In map areas one, two, and three, occasional small patches of well-drained Brunisolic soils are found on steep slopes, mostly south-facing. High rates of moisture runoff and evaporation, and, in turn, low moisture infiltration and percolation rates, lead to minimal soil profile development. Well- to imperfectly drained Brunisolic soils are also found in stream floodplains of map areas one and three. Since the fluvial sediments have been deposited relatively recently, the soil profile has not yet developed extensively. One other small patch of well-drained Brunisolic soils is found under grassland, in the southeastern corner of map area one. Grassland favors the development of Chernozemic soils, but the cool climate in this region precludes the formation of Chernozemic Ah horizons.

Regosolic soils are well- to imperfectly drained mineral soils with profile development far too weakly expressed to meet the requirements for classification in any other order. These soils lack any expression of a B horizon, and reflect essentially the characteristics of the C horizons and the parent materials from which they are formed.

Well- to imperfectly drained Regosolic soils are associated with the Brunisolic soils in the stream floodplains of map areas one and three. Regosolic soils also appear extensively where Boulton Creek flows into Lower Kananaskis Lake. These soils reflect the youthfulness of the fluvial sediments even more than the Brunisolic soils.

Soils of the Gleysolic order are poorly drained mineral soils, whose profiles reflect the influence of waterlogging for significant periods. Water saturation causes reducing conditions due to a lack of aeration. These conditions result in gleyed horizons having dull gray to olive, greenish- or bluish-gray moist colors, frequently accompanied by prominent mottles, usually rust colored from localized oxidation and reduction of hydrated iron oxides. Gleysolic soils occur sporadically, usually in small depressions and low areas, throughout the four map areas.

Soils of the Organic order have developed largely from organic deposits. These soils contain more than 30 percent organic matter by weight, and meet minimum specifications of depth and thickness within a defined control section.

For most of the year, many Organic soils are either water saturated, or nearly so, unless artificially drained. The organic deposits are derived primarily from the decomposition of hydrophytic or mesohydrophytic vegetation. The further classification and naming of the great groups into Fibrisols, Mesisols, and Humisols depends on the occurrence and identification of three major diagnostic layers: Fibric, Mesic, and Humic.

Fibric layers are the least decomposed of all the organic soil materials, so the fibers' botanical identities are easily recognized. On the other hand, humic layers are highly decomposed, and often the soil has a smooth greasy feel when moist.

The humic layer has the least amount of recognizable plant fiber, and is usually darker in color than fibric or mesic materials. This layer is relatively stable and changes little in physical or chemical composition with time.

The organic matter of mesic layers is in an intermediate stage of decomposition between that of fibric and humic

layers, and has been partially altered, both chemically and physically. In areas where Organic soils are cultivated, controlling drainage, adequate fertilization, and tillage practices that ensure a firm bed for seed germination and root development may become problems. Overdrainage and dessication of peat are detrimental to crop production and to the maintenance of the organic layers in a desirable physical condition. When cultivated, many Organic soils show deficiencies in macro and micro mineral nutrients; most need phosphorus and potassium to reach maximum productivity.

Organic soils pose special problems for construction: they have low bearing strength, high shrink-swell potential, and susceptibility to frost heaving. Organic soils are found extensively in glacial meltwater channels and other low portions of the landscape throughout the four map areas, but they are most prominent in areas one and three.

Although only slight differences are observed among some map units, they are generally significant enough, for some recreational or engineering uses, to justify their separation. The wide variations in horizon thicknesses, reported in some of the following map unit descriptions, demonstrate the extreme variability commonly found in soils. Thickness of comparative horizons of the same soil series can vary as much as 10 to 40 percent from the norm at different points in the landscape.

Dominant plant species are listed by their common names. These lists are very general, and are not exhaustive.

MAP UNIT 1

Classification: Brunisolic Gray Luvisol
Parent Material: moderately coarse-textured, gravelly, cobbly till – 70%, gravel – 30%
Landform: level morainal - level glaciofluvial (Ml - F^{G}_{l}, undulating morainal - undulating glaciofluvial (Mu - F^{G}_{u}) hummocky morainal - hummocky glaciofluvial (Mh - F^{G}_{h})
Slope: gently undulating to hilly (>0.5% to 60%)
Surface Stoniness: moderately to exceedingly stony (2 to 4)
Drainage: well drained
Vegetation: predominantly lodgepole pine with an understory of Canadian buffalo-berry, grass and forbs; at higher elevations, alpine fir and white spruce predominate, with an understory of false huckleberry and white-flowered rhododendron
Profile Description: Brunisolic Gray Luvisol developed from till

Horizon	Thickness cm	Lab Texture	Structure	Consistence	pH $CaCl_2$	O.M.[1] %
L-H	1 to 7	leaf litter (predominantly pine needles)			5.0	32.6
Ae1	0 to 5 (occasional tonguing to 10)	silt loam	platy	very friable, moist	4.8	3.66
Bm	8 to 16	silt loam	platy	very friable, moist	5.0	1.41
Ae2	4 to 9	silt loam	platy	very friable, moist	5.4	0.87
Bt	3 to 10	loam	subangular blocky	friable, moist	6.2	nd[2]
Cca	at 26 to 35	sandy loam	amorphous	loose, moist	6.5	nd[2]

[1]O.M. - organic matter
[2]nd - not determined

Brunisolic Gray Luvisol developed from gravel – this soil description is identical to that of the former, with the following exceptions:

Horizon	Thickness cm	Lab Texture	Structure	Consistence	pH $CaCl_2$	O.M. %
Bt		slightly coarser textured				
Cca		gravel				

Comments: (1) The two parent material types of Map Unit 1 soils are intimately and unpredictably associated; however, the till appears to be more prevalent than the gravel throughout most of the mapped area. (2) The parent materials of these soils can serve as a source of gravel, but on-site investigation is needed to pinpoint specific locations of gravel deposits. (3) The L-H horizons of Map Unit 1 soils are commonly very thin and fragile (1 to 5 cm thick), as they are comprised dominantly of pine needles. They are easily destroyed by foot traffic and afford little protection against soil erosion. At higher elevations, however, where spruce and fir predominate over pine, a significantly more profuse moss growth is common. The L-H horizons are comprised dominantly of moss and roots, and are much thicker (7 to 14 cm). This affords a much greater degree of protection of the soil surface against erosion.
Limitations: None to slight on suitable topography for buildings, septic tank absorption fields, trench-type sanitary landfills, and road location; moderate on suitable topography for all other uses; good source of roadfill; poor source of gravel due to unsuitable texture. Specific limitations include surface stoniness, slippery or sticky when wet, lack of Ah horizon, excessive slope and soil erosion hazard.

MAP UNIT 2

Classification: Orthic and Eluviated Eutric Brunisol (these two subgroups are intimately and unpredictably associated)
Parent Material: medium- to very coarse-textured, gravelly, cobbly till, with occasional pockets of gravel
Landform: undulating morainal (Mu), hummocky morainal (Mh), inclined morainal (Mi)
Slope: undulating to very steeply sloping and hilly (>2 to 60%)
Surface Stoniness: very stony to excessively stony (3 to 5)
Drainage: well to rapidly drained
Vegetation: Forested areas of predominantly alpine fir and an understory of white-flowered rhododendron, some white spruce and false huckleberry, some alpine larch near the tree line. Nonforested areas on dry, south-facing slopes support grass, bearberry and other forbs, scattered Canadian buffalo-berry and ground juniper.
Profile Description:

Orthic and Eluviated Eutric Brunisol

Horizon	Thickness cm	Field Texture	Structure	Consistence
L-H	2.5 to 5 (patches to 10)	leaf litter	turfy	
Ae	0 to 7.5 (discontinuous)	very fine sandy loam	platy	very friable, moist
Bm	2.5 to 20	gravelly very fine sandy loam	amorphous	loose, moist; soft, dry
BC	0 to 35 (discontinuous)	very gravelly very fine sandy loam	amorphous	loose, moist; soft, dry
Cca	at 12 to 50	very gravelly loam to very gravelly sandy loam	subangular blocky to single grain	very friable to loose, moist

MAP UNIT 2 (continued)

Orthic Eutric Brunisol - eroded phase

Horizon	Thickness cm	Lab Texture	Structure	Consistence	pH $CaCl_2$	O.M. %
Bm	9	silt loam	amorphous	soft, dry	7.2	4.32
Cca	at 9	gravel (field texture)	amorphous	loose, moist	7.4	1.47

Comments: Dry, south-facing slopes and escarpments are severely eroded. They consist of alternating patches of bare ground where the Bm horizon is exposed at the surface, and vegetation cover (about 50 - 50). The soils on these slopes have all been classified in the Orthic subgroup, and the profiles are gravelly to the surface.
Limitations: Slight on suitable topography for buildings and road location; severe for lawns and landscaping, septic tank absorption fields and trench-type sanitary landfills; moderate on suitable topography for all other uses. Good source of road-fill on suitable topography; fair source of gravel (unsuitable texture). Specific limitations include surface stoniness, excessive slope, erosion hazard, slippery or sticky when wet, lack of Ah horizon, high lime content (soil nutrient imbalance), rapid permeability (droughtiness) and groundwater contamination hazard.

MAP UNIT 3

Classification: Orthic Eutric Brunisol and Orthic Regosol (these two soil types are intimately and unpredictably associated)
Parent Material: medium- to very coarse-textured fluvial sediments overlying gravel
Landform: level fluvial (Fl), undulating fluvial (Fu)
Slope: gently undulating to undulating (>0.5% to 5%)
Surface Stoniness: non-stony to very stony (0 to 3)
Drainage: well drained
Vegetation: lodgepole pine, white spruce, willow, Canadian buffalo-berry, grass, forbs, moss, some horsetail
Profile Description:

Orthic Eutric Brunisol

Horizon	Thickness cm	Field Texture	Structure	Consistence
L-H	5 to 10	leaf litter		
Bm	10 to 20	loam to fine sandy loam	granular	very friable, moist
Cca1	20 to 45	very fine sandy loam to loamy fine sand	amorphous	loose, moist; soft, dry
Cca2	at 40 to 55	gravel	amorphous	loose, moist

Orthic Regosol

Horizon	Thickness cm	Lab Texture	Structure	Consistence	pH $CaCl_2$	O.M. %
L-H	5 to 6	root litter			5.8	40.8
Ck1	15 to 19	silt loam	amorphous	very friable, moist	7.2	6.87
Ck2	at 15 to 19	silt loam	amorphous	very friable, moist	7.6	nd
Ck3	at 60	gravel	amorphous	loose, moist	nd	nd

MAP UNIT 3 (continued)

Comments: (1) During the 1977 mapping program, Orthic Regosol soils were found with a higher frequency than indicated in the 1976 soil report.

(2) The depth-to-gravel ranges from zero to 60 cm, but is most commonly 25 to 40 cm; found at the surface in less than 10 percent of the Map Unit 3 soils areas.

Limitations: Moderate for picnic areas, paths, trails, lawns and landscaping; severe for all other uses. Poor source of roadfill, fair source of gravel. Specific limitations include flooding hazard (overflow), slippery or sticky when wet, lack of Ah horizon, high lime content (soil nutrient imbalance), susceptibility to frost heave, moderate shrink-swell potential, rapid permeability, groundwater contamination hazard, and surface stoninesss.

MAP UNIT 4

Classification: Brunisolic Gray Luvisol
Parent Material: medium- to moderately coarse-textured, gravelly, cobbly till
Landform: inclined morainal (Mi), undulating morainal (Mu), hummocky morainal (Mh)
Slope: gently sloping and undulating, to very steeply sloping and hilly (>2 to 60%)
Surface Stoniness: moderately to excessively stony (2 to 5)
Drainage: well drained
Vegetation: predominantly lodgepole pine with an understory of Canadian buffalo-berry, grass and forbs; at higher elevations, alpine fir and white spruce predominate, with an understory of false huckleberry and white-flowered rhododendron
Profile Description:

Brunisolic Gray Luvisol

Horizon	Thickness cm	Lab Texture	Structure	Consistence	pH $CaCl_2$	O.M. %
L-H	6	needle and root litter			3.6	75
Ae1	2 to 5	silt loam	platy	soft, dry	4.0	4.15
Bm	11 to 19	silt loam	platy	soft, dry	5.8	2.86
Ae2	7 to 10	silt loam	platy	soft, dry	5.6	nd
Bt	10 to 17	silt loam to loam	subangular blocky	slightly hard, dry	6.8	nd
Cca	at 55	silt loam	amorphous	soft, dry	7.4	nd

Comments: (1) These soils are identical to the 70 percent member of Map Unit 1.

(2) The L-H horizon of Map Unit 4 soils is commonly very thin and fragile (1 to 5 cm thick), as it is comprised dominantly of pine needles. This horizon is easily destroyed by foot traffic and affords little protection against soil erosion. At the higher elevations, where spruce and fir predominate over pine, a significantly more profuse moss growth is common. The L-H horizon, which is comprised dominantly of moss and roots, is much thicker (7 to 14 cm) and provides correspondingly increased protection against erosion.

Limitations: None to slight on suitable topography for buildings, septic tank absorption fields, trench-type sanitary landfills, and road location; moderate on suitable topography for all other uses. Good source of roadfill on suitable topography; poor source of gravel because of unsuitable texture. Specific limitations include surface stoniness, slippery or sticky when wet, excessive slope, erosion hazard and lack of Ah horizon.

MAP UNITS 5 AND 6

These soils were not mapped during the 1977 program, so are not described in this report.

MAP UNIT 7

Classification: Brunisolic Gray Luvisol
Parent Material: medium- to moderately fine-textured till containing a high proportion of weathered shale
Landform: hummocky morainal (Mh)
Slope: strongly rolling (>15 to 30%)
Surface Stoniness: non-stony to slightly stony (0 and 1)
Drainage: well drained
Vegetation: lodgepole pine, Canadian buffalo-berry, grass, forbs; some white spruce and ground juniper
Profile Description:

Brunisolic Gray Luvisol

Horizon	Thickness cm	Lab Texture	Structure	Consistence	pH $CaCl_2$	O.M. %
L-H	1 to 2	needle and root litter			5.3	51.4
Ae1	1 to 5	silt loam	platy	soft, dry	5.1	4.67
Bm	2 to 7	silt loam	platy	soft, dry	5.3	3.32
Ae2	3 to 6	silt loam	platy	slightly hard, dry	4.7	nd
Bt	25	silty clay loam	subangular blocky	firm, moist	6.9	nd
Cca	at 40	silt loam to silty clay loam	subangular blocky	friable, moist	7.3	nd

Comments: These soil profiles contain only a few small stones and flat shale fragments.
Limitations: Moderate for primitive camping areas and trails; severe for all other uses. Poor source of roadfill; unsuitable as a source of sand or gravel because of unsuitable texture. Specific limitations include excessive slope, erosion hazard, slippery or sticky when wet, lack of Ah horizon, susceptibility to frost heave, and moderate shrink-swell potential.

MAP UNIT 8

Classification: Orthic Regosol
Parent Material: medium- to moderately fine-textured fluvial sediments overlying gravel
Landform: fluvial fan (Ff)
Slope: very gently sloping to gently sloping, and moderately rolling (>0.5 to 5% and >9 to 15%)
Surface Stoniness: non-stony (0)
Drainage: well drained
Vegetation: usually none, occasional patches of sparse short grass
Profile Description:

Orthic Regosol

Horizon	Thickness cm	Field Texture	Structure	Consistence
Ck1	45 to 120	silt loam	amorphous	very friable, moist
Ck2	at 45 to 120	gravel	amorphous	loose, moist

Comments: (1) Occasionally layers of silty clay-loam-textured material are found in soil profiles of Map Unit 8. These layers commonly occur at depths of 25 to 45 cm, range in thickness from 10 to 20 cm, have amorphous structure, and firm moist consistence.

(2) Patches of gravel are found at the surface sporadically and these comprise about 20 percent of the soil areas of Map Unit 8.
Limitations: Moderate for picnic areas, and lawns and landscaping; severe for all other uses. Poor source of roadfill and gravel. Specific limitations include flooding hazard (overflow), slippery or sticky when wet, susceptibility to frost heave, moderate shrink-swell potential, rapid permeability, groundwater contamination hazard, lack of Ah horizon, high lime content (soil nutrient imbalance), excessive slope, and erosion hazard.

MAP UNIT 9

Classification: Rego and Orthic Gleysol (these two subgroups are intimately and unpredictably associated)
Parent Material: medium- to very coarse-textured fluvial sediments overlying gravel
Landform: level fluvial (Fl)
Slope: nearly level to gently undulating (0 to 2%)
Surface Stoniness: non-stony (0)
Drainage: poorly drained
Vegetation: willow, grass, slough grass, moss, some white spruce
Profile Description:

Rego and Orthic Gleysol

Horizon	Thickness cm	Field Texture	Structure	Consistence
Bg or Cgk	12 to 25	loam to loamy sand	amorphous	very friable to loose, moist
Ccag1	at 12 to 25	loam to loamy sand	amorphous	very friable to loose, moist
Ccag2	at 45 to 100	gravel	amorphous	loose, moist

Comments: A water table is occasionally found within 30 cm of the surface.
Limitations: Severe for all uses. Poor source of roadfill and gravel. Specific limitations include seasonally high groundwater table or surface ponding, flooding hazard (overflow), lack of Ah horizon, and groundwater contamination hazard.

MAP UNIT 10

Classification: Orthic Regosol
Parent Material: gravel
Landform: level fluvial (Fl)
Slope: gently undulating (>0.5 to 2%)
Surface Stoniness: exceedingly to excessively stony (4 and 5)
Drainage: very rapidly drained
Vegetation: white spruce, lodgepole pine, willow, Canadian buffalo-berry, grass, forbs; some ground juniper and shrubby cinquefoil
Profile Description:

Orthic Regosol

Horizon	Thickness cm	Field Texture	Structure	Consistence
L-H	2.5 to 5	leaf and root litter		
Ck	at 0	gravel	amorphous	loose, dry or moist

Limitations: Moderate for picnic areas, paths and trails; severe for all other uses. Good source of roadfill, poor source of gravel. Specific limitations include surface stoniness, flooding hazard (overflow), lack of Ah horizon, high lime content (soil nutrient imbalance), rapid permeability (droughtiness), and groundwater contamination hazard.

MAP UNIT 11

Classification: Gleyed Regosol and Gleyed Eutric Brunisol (these two soil types are intimately and unpredictably associated)
Parent Material: medium-textured fluvial sediments overlying gravel
Landform: level fluvial (Fl), undulating fluvial (Fu)
Slope: gently undulating to undulating (>0.5 to 5%)
Surface Stoniness: non-stony to slightly stony (0 and 1)
Drainage: imperfectly drained
Vegetation: willow, grass, forbs; some white spruce and moss
Profile Description:

Gleyed Regosol

Horizon	Thickness cm	Lab Texture	Structure	Consistence	pH $CaCl_2$	O.M. %
L-H	2 to 4	root and moss litter			6.2	41.7
Ckgj	50	silt loam to loam	amorphous	very friable, moist	7.4	9.42
Ckg1	50 to 100	silt loam	amorphous	very friable, moist	7.4	nd
Ckg2	at 100	gravel	amorphous	loose, moist	not sampled	

Comments: (1) The preceding soil profile description is also applicable to the Gleyed Orthic Eutric Brunisols of Map Unit 11, with the exception that a Bmg horizon occurs in place of the Ckgj horizon.

(2) Occasional sand lenses are found in Map Unit 11 soil profiles. These lenses can be found at any depth within the control section, range from sand to loamy sand in texture, 5 to 10 cm thick, have amorphous structure, and have loose consistence when moist.

(3) The depth to gravel ranges from 25 to 100 cm below the surface.

(4) A water table sometimes occurs within 75 cm of the surface.

Limitations: Moderate for picnic areas, paths, trails, and lawns and landscaping; severe for all other uses. Poor source of roadfill and gravel. Specific limitations include flooding hazard (overflow), seasonally high groundwater table, slippery or sticky when wet, susceptibility to frost heave, moderate shrink-swell potential, groundwater contamination hazard, lack of Ah horizon, and high lime content (soil nutrient imbalance).

MAP UNIT 12

Classification: Orthic Gray Luvisol
Parent Material: medium- to moderately coarse-textured glaciofluvial sediments overlying gravel
Landform: undulating glaciofluvial (F^{G}_{U})
Slope: undulating (>2 to 5%)
Surface Stoniness: non-stony to slightly stony (0 and 1)
Drainage: well drained
Vegetation: lodgepole pine, Canadian buffalo-berry, white spruce, grass, forbs, some ground juniper
Profile Description:

Orthic Gray Luvisol

Horizon	Thickness cm	Lab Texture	Structure	Consistence	pH $CaCl_2$	O.M. %
L-H	2 to 5	moss and root litter			5.7	23.6
Ae	1 to 6	silt loam	platy	soft, dry	4.8	4.39
AB	3 to 7	silt loam	platy	very friable, moist	4.4	3.18

MAP UNIT 12 (continued)

Horizon	Thickness cm	Lab Texture	Structure	Consistence	pH $CaCl_2$	O.M. %
Bt	6 to 12	loam	amorphous	very friable, moist	5.6	5.25
Cca1	28	sandy loam	amorphous	loose, moist	7.1	nd
Cca2	28	sandy loam	amorphous	very friable, moist	7.3	nd
Ccag1	at 76	loam	amorphous	loose, moist	7.3	nd
Ccag2	at 100	gravel	amorphous	loose, moist	not sampled	

Comments: The depth to gravel ranges from 25 to 100 cm below the surface.
Limitations: None to slight for buildings without basements; severe for buildings with basements, septic tank absorption fields, trench-type sanitary landfills, and road location; moderate for all other uses. Poor source of roadfill and good source of gravel. Specific limitations include slippery or sticky when wet, susceptibility to frost heave, moderate shrink-swell potential, rapid permeability, groundwater contamination hazard, and lack of Ah horizon.

MAP UNIT 13

Classification: Orthic Gleysol and Orthic Luvic Gleysol (peaty and non-peaty phases) (these two great groups and the two phases are intimately and unpredictably associated)
Parent Material: moderately coarse-textured to moderately fine-textured till
Landform: level morainal (Ml), inclined morainal (Mi), and hummocky morainal (Mh)
Slope: nearly level and very gently sloping to moderately rolling and steeply sloping (0 to 30%)
Surface Stoniness: non-stony to exceedingly stony (0 to 4)
Drainage: poorly drained
Vegetation: willow, slough grass, moss; sometimes swamp birch and shrubby cinquefoil
Profile Description:

Orthic Gleysol

Horizon	Thickness cm	Field Texture	Structure	Consistence
Oh	5 to 30	well decomposed organic material		
Bg	40 to 90 (layers 10 to 75 cm thick)	silt loam to clay loam	amorphous	very friable to very firm, moist
Ccag	at 40 to 90	clay loam to gravelly sandy clay loam	amorphous	very firm, moist; plastic and sticky, wet

Orthic Luvic Gleysol

Horizon	Thickness cm	Field Texture	Structure	Consistence
Of	0 to 10	relatively undecomposed organic material		
Om	0 to 10	partially decomposed organic material		
Oh	5 to 20	well-decomposed organic material		

MAP UNIT 13 (continued)

Horizon	Thickness cm	Field Texture	Structure	Consistence
Aeg	7 to 15	silt loam	platy	very friable, moist
Btg	7 to 18	silty clay loam to clay loam	subangular blocky	firm to friable, moist
Ccag	at 20 to 25	gravelly loam to gravelly sandy loam	amorphous	very friable to loose, moist

Comments: Wherever micro peat hummocks occur on the soil surface, Of and Om horizons are the main components.
Limitations: Severe for all uses. Poor source of roadfill; unsuitable as a source of sand or gravel (unsuitable texture). Specific limitations include seasonally high groundwater table or surface ponding, slippery or sticky when wet, organic surface layer more than 15 cm thick, susceptibility to frost heave, moderate shrink-swell potential, lack of Ah horizon, excessive slope, erosion hazard, and surface stoniness.

MAP UNIT 14

Classification: Orthic Humic Gleysol
Parent Material: medium- to moderately fine-textured till containing a high proportion of weathered shale
Landform: level morainal (Ml)
Slope: nearly level (0 to 0.5%)
Surface Stoniness: non-stony (0)
Drainage: poorly drained
Vegetation: willow, grass
Profile Description:

Orthic Humic Gleysol

Horizon	Thickness cm	Field Texture	Structure	Consistence
Ah	10 to 13	silt loam	amorphous	very friable, moist
Bg	at 10 to 13 (continuous to 100)	silt loam to silty clay loam	amorphous	hard, dry; friable to very friable, moist

Comments: The soil profile contains about 10 to 20 percent small shale fragments.
Limitations: Severe for all uses. Poor source of roadfill; unsuitable as a source of sand or gravel because of unsuitable texture. Specific limitations include seasonally high groundwater table or surface ponding, slippery or sticky when wet, susceptibility to frost heave, moderate shrink-swell potential, and groundwater contamination hazard.

MAP UNIT 15

Classification: Orthic Melanic Brunisol
Parent Material: medium-textured stony till
Landform: hummocky morainal (Mh)
Slope: moderately rolling (>9 to 15%)
Surface Stoniness: very stony (3)
Drainage: well drained
Vegetation: grass, forbs

MAP UNIT 15 (continued)

Profile Description:

Orthic Melanic Brunisol

Horizon	Thickness cm	Lab Texture	Structure	Consistence	pH $CaCl_2$	O.M. %
Ah	12	silt loam	amorphous	very friable, moist	6.4	17.1
Bm	34	silt loam	amorphous	very friable, moist	6.4	1.71
Cca	at 46	silt loam	amorphous	very friable, moist	7.6	nd

Comments: The landscape of Map Unit 15 has the appearance of a meadow.
Limitations: None to slight for trench-type sanitary landfills; severe for buildings with basements and road location; moderate for all other uses. Poor source of roadfill; unsuitable as a source of sand or gravel because of unsuitable texture. Specific limitations include excessive slope, erosion hazard, slippery or sticky when wet, susceptibility to frost heave, moderate shrink-swell potential, and surface stoniness.

MAP UNIT 16

Classification: Orthic Humic Gleysol
Parent Material: medium- to moderately fine-textured stony till
Landform: undulating morainal (Mu)
Slope: undulating (>2 to 5%)
Surface Stoniness: very stony (3)
Drainage: poorly drained
Vegetation: grass, forbs; patches of slough grass and silverweed
Profile Description:

Orthic Humic Gleysol

Horizon	Thickness cm	Field Texture	Structure	Consistence
Ah	10 to 13	loam to very fine sandy loam	amorphous	very friable, moist
Bg	35	silty clay loam	prismatic, breaking to blocky	firm to very firm, moist
Ccag	at 45	silt loam to silty clay loam	amorphous	friable to firm, moist

Limitations: Severe for all uses. Poor source of roadfill; unsuitable as a source of sand or gravel because of unsuitable texture. Specific limitations include seasonally high groundwater table or surface ponding, slippery or sticky when wet, susceptibility to frost heave, moderate shrink-swell potential, groundwater contamination hazard, and surface stoniness.

M (Organic soil)

Classification: Mesisol
Parent Material: predominantly intermediately decomposed peat
Landform: horizontal fen (Nh), sloping fen (Ns)
Slope: nearly level and strongly sloping (0 to 0.5% and >9 to 15%)
Surface Stoniness: non-stony (0)

MAP UNIT 16 (continued)

Drainage: very poorly drained
Vegetation: swamp birch, sedge, moss; scattered white spruce and lodgepole pine; some Labrador tea
Profile Description:

Mesisol

Horizon	Thickness cm	Field Description
Of	0 to 25	relatively undecomposed peat
Om	135 to 160	predominantly intermediately decomposed peat

Comments: The Of horizons are the main components of micro peat hummocks found on the soil surface.
Limitations: Unsuitable for buildings, septic tank absorption fields, trench-type sanitary landfills, as a source of roadfill and of sand or gravel, severe for all other uses. Specific limitations include organic soil, seasonally high groundwater table, high shrink-swell potential, susceptibility to frost heave, groundwater contamination hazard, lack of Ah horizon, and excessive slope.

T.M. (Organic Soil)

Classification: Terric Mesisol
Parent Material: predominantly intermediately decomposed peat overlying undifferentiated mineral material
Landform: sloping fen (Ns)
Slope: gently sloping (>2 to 5%)
Surface Stoniness: non-stony (0)
Drainage: very poorly drained
Vegetation: swamp birch, slough grass, moss, willow, Labrador tea, shrubby cinquefoil, scattered white spruce
Profile Description:

Terric Mesisol

Horizon	Thickness cm	Field Description
Of	15	relatively undecomposed peat
Om	105	predominantly intermediately decomposed peat
Cg	at 120	undifferentiated mineral material

Comments: The mineral material can be expected to be similar to the parent material of adjacent mineral soils.
Limitations: Unsuitable for buildings, septic tank absorption fields, trench-type sanitary landfills, as a source of roadfill and of sand or gravel; severe for all other uses. Specific limitations include organic soil, seasonally high groundwater table, high shrink-swell potential, susceptibility to frost heave, groundwater contamination hazard, and lack of Ah horizon.

H (Organic Soil)

Classification: Humisol
Parent Material: predominantly highly decomposed peat
Landform: horizontal fen (Nh) and sloping fen (Ns)
Slope: nearly level and gently sloping (0 to 0.5% and >2 to 5%)
Surface Stoniness: non-stony (0)
Drainage: very poorly drained
Vegetation. slough grass, moss; willow around fringes

H (Organic Soil)(continued)

Profile Description:

Humisol

Horizon	Thickness cm	Field Description
Oh	160	predominantly highly decomposed peat

Limitations: Unsuitable for buildings, septic tank absorption fields, trench-type sanitary landfills, as a source of roadfill and of sand or gravel; severe for all other uses. Specific limitations include organic soil, seasonally high groundwater table, high shrink-swell potential, susceptibility to frost heave, groundwater contamination hazard, and lack of Ah horizon.

T.H. (Organic Soil)

Classification: Terric Humisol
Parent Material: predominantly highly decomposed peat overlying undifferentiated mineral material
Landform: horizontal fen (Nh) and sloping fen (Ns)
Slope: nearly level to gently undulating, and gently sloping to steeply sloping (0 to 30%)
Surface Stoniness: non-stony (0)
Drainage: very poorly drained
Vegetation: swamp birch, slough grass, moss; some shrubby cinquefoil; often some willow and scattered lodgepole pine and black spruce; occasional Labrador tea
Profile Description:

Terric Humisol

Horizon	Thickness cm	Field Description
Of	5 to 25	relatively undecomposed peat
Oh	75	predominantly highly decomposed peat
Cg	at 80 to 100	undifferentiated mineral material

Comments: (1) The mineral material can be expected to be similar to the parent material of adjacent mineral soils.
(2) Occasional layers of intermediately decomposed peat, ranging from 10 to 40 cm in thickness, are found at varying depths.
(3) Near the margins of Terric Humisol soil areas, peat is often less than 40 cm thick. In these instances, the soils can be classified as peaty phases of Gleysolic soils.
(4) The Terric Humisol soil areas are commonly bordered by escarpments.
Limitations: Unsuitable for buildings, septic tank absorption fields, trench-type sanitary landfills, as a source of roadfill and of sand or gravel. Specific limitations include organic soil, seasonally high groundwater table, high shrink-swell potential, susceptibility to frost heave, groundwater contamination hazard, lack of Ah horizon, and excessive slope.

MISCELLANEOUS LAND TYPES

S.R. Surface Removed. The soil solum has been removed by construction activities in these areas, exposing the soil parent material. The texture, surface stoniness, and limitations of these areas are variable, but are generally similar to those of surrounding soils.

B.P. Borrow Pit. These are excavations made during construction activities.

G.P. Gravel Pit.

S.L.F. Sanitary Landfill.

S.D. Sawdust. This is a heap of sawdust left by a sawmill, formerly located on the site.

R.S. Rubbly Shoreline. These are steeply inclined lake shorelines, consisting dominantly of cobbly and

angular cobbly loose rubble. They have severe limitations for all uses because of a flooding hazard caused by fluctuating lake water levels, their steep slopes and their extremely rubbly nature.

B. Beaver Pond. These are flooded areas caused by water backed up behind beaver dams.

This symbol indicates escarpments. They have severe limitations for all uses because of the extreme slopes.

This symbol indicates bedrock outcrops, generally limestone. These are generally very steeply sloping and devoid of vegetation and soil, and therefore have severe limitations for all uses.

SOIL INTERPRETATIONS

Soil interpretations are predictions of soil performance under different uses, based on evaluations of the soil to a depth of about 100 cm. Some interpretations, however, can be made below the 150 cm depth. The interpretations are based largely on soil descriptions and observations made during the field soil mapping program. Horizon samples of representative soil profiles were collected for routine chemical analyses, and a few deeper samples were collected for engineering tests. Engineering properties of some map units sampled were extrapolated to other map units not sampled, where soils of the different map units were developed on like, or very similar, parent materials. The results of chemical and physical analyses are given in Tables 4 and 5.

It is important that these soil interpretations be viewed with the proper perspective. The interpretations are for soils in the natural, undisturbed state only. Other factors such as location, aesthetic values, and nearness to population centres are not considered. A soil survey, properly interpreted, is a useful guide for general recreation planning and site selection, but all soil differences found in the field cannot be shown on the soil map. Before constructing specific recreational facilities, an investigation of the site is usually required.

The soil interpretations are not recommendations for land use, and do not eliminate the need for land-use planning. Nevertheless, these interpretations are valuable tools for the planner, since they indicate the limitations and suitabilities of various kinds of soil for particular uses. The planner can use the interpretations to help predict the type and degree of problems likely to be encountered, and plan the kind and amount of on-site investigation needed to determine corrective measures. The actual number of on-site investigations can be reduced considerably by a soil survey map and its accompanying soil interpretations.

Using the basic soil survey data of an area, it is possible to make soil performance predictions, based on field soil morphology and physical and chemical properties of the soil. Soils in the provincial parks are used mainly for recreational pursuits and building sites; and as road construction materials.

Definitions of the soil limitations and suitability ratings are as follows (United States Department of Agriculture, Unpublished Guide):

1. A *none to slight* soil limitation is the rating given soils that have properties favorable for the rated use. The degree of limitation is minor and can be overcome easily. Good performance and low maintenance can be expected.

2. A *moderate* soil limitation is the rating given soils that have properties moderately favorable for the rated use. This degree of limitation can be overcome or modified by special planning, design, or maintenance. During some part of the year, the performance of the planned use is somewhat less desirable than for soils rated slight. Some soils rated moderate require treatment such as artificial drainage, runoff control to reduce erosion, extended sewage absorption fields, extra excavation, or some modification of certain features through manipulation of the soil. For these soils, modification is needed for construction plans generally used for soils of slight limitations. Modification may include special foundations, extra reinforcement of structures, sump pumps, and the like.

3. A *severe* soil limitation is the rating given soils that have one or more properties unfavorable for the rated use, such as steep slopes, bedrock near the surface, flooding hazard, high shrink-swell potential, a seasonal high water table, or a sandy surface texture. This degree of limitation generally requires major soil modification, special design, or intensive maintenance. Modification might require the soil material to be removed or replaced. Some of these soils can be improved by reducing or removing the soil feature that limits its use, but, in most situations, it is difficult and costly to alter the soils or design a structure that compensates for a severe degree of limitation.

4. A rating of *good* means the soils have properties favorable for the rated use. Good performance and minimal maintenance can be expected.

5. A rating of *fair* means the soil is moderately favorable for the rated use. One or more soil properties make these soils less desirable than those rated good.

6. A rating of *poor* means the soil has one or more properties unfavorable for the rated use. Overcoming the unfavorable property requires special design, extra maintenance, or costly alteration.

7. A rating of *unsuitable* means the soil cannot be used for the rated use.

In general, the soils most suited for recreational development are those of Map Units 1, 2, 3, 4, 7, 8, 10, 11, 12, and 15, when found on favorable topography. All map units have moderate to severe limitations for specific uses, however, because of factors such as slippery or sticky when wet, surface stoniness, flooding hazard (overflow), seasonally high groundwater table or surface ponding, lack of Ah horizon, high lime content (soil nutrient imbalance), and rapid permeability (droughtiness). In addition, many map units have severe limitations in numerous locations from excessive slopes, resulting in soil erosion hazards. The soils most suited for recreational uses in the mapped area are probably those of Map Unit 12.

Soils of Map Units 1, 2, 4, 12 and 15 are the most favorable for building sites and road construction when found on suitable topography. The soils of Map Unit 15 have moderate, to severe, limitations because of susceptibility to frost-heave* and moderate shrink-swell potential. In addition, the soils of Map Units 2 and 12 have rapid permeabilities, and may have severe limitations because of a groundwater contamination hazard, when found in close proximity to lakes, streams, organic soil areas, and other locations where high water tables are found.

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*Contingent upon an abundant supply of moisture. Frost heaving is not generally considered to be a serious problem for roads in Alberta except in poorly drained locations where the water table is near the soil surface, or when high amounts of rainfall are received shortly before freezing (Greenlee, 1981). In well drained locations, the water table is normally low enough so that frost heaving rarely takes place. Consequently the hazard "susceptibility of soils to frost heaving" has been given only minor consideration in determining a soil's overall limitation for a particular use. Exceptions are soils having high or fluctuating water tables. These soils may be highly susceptible to frost heaving, depending upon texture.

The soils of Map Unit 12 constitute a good source of gravel, and those of Map Units 2 and 3, a fair source. The soils of many other map units have unsuitable textures, and some are poor sources because of a flooding hazard (overflow), or excessive wetness.

The soils of Map Units 9, 13, 14 and 16 have severe limitations for all uses. These map units have Gleysolic soils and, consequently, seasonally high groundwater tables or surface ponding, in addition to various other limitations.

The Organic soil map units have severe limitations for all uses from the inherent properties of Organic soils and their extreme wetness. In addition, these map units are unsuitable for some uses including building sites, and as sources of roadfill, sand, or gravel.

Severe limitations do not necessarily prevent the use of certain soils for recreational purposes, road construction, or building sites; however, when planning or constructing park facilities, it is important to bear in mind the limitations, since to alleviate them may require careful or expensive construction. The limitations and suitabilities of the various soils for selected uses are shown in Tables 6 to 18 inclusive. The ratings were determined on the basis of soul morphological, physical and chemical properties, as well as steepness of slope. The principal limiting properties are indicated, and are generally listed in decreasing order of importance.

Limitations because of slope are not further subdivided once the slope becomes steep enough to render a severe limitation for a specific use. It follows, however, that the steeper the slope, the more severe the limitations, and this fact should be borne in mind while using the soil interpretation tables. In Tables 6 to 16 inclusive, the soil limitations for various uses have been designated as none to slight, moderate, severe and unsuitable. In Tables 17 and 18, suitabilities of soils as sources of roadfill and as sources of sand or gravel, respectively, have been designated as good, fair, poor, and unsuitable.

TABLES

TABLE 4.
Chemical and Physical Analyses of Soil Samples from Kananaskis Lakes Park

Map Unit	Horizon	Depth (cm)	pH $CaCl_2$	pH H_2O	Exchangeable Cations [1]meq/100 g				[2]CEC meq/100 g
					Na	K	Ca	Mg	100 g
1	L-H	4-0	5.0	5.3	0.05	1.2	34.7	4.9	66.2
	Ae1	0-3	4.8	5.5	0.06	0.2	5.5	0.73	13.7
	Bm	3-15	5.0	6.0	0.14	0.10	2.2	0.26	11.9
	Ae2	15-21	5.4	5.8	0.25	0.09	9.3	0.67	9.6
	Bt	21-26	6.2	6.5	0.07	0.20	41.3	1.7	17.9
	Cca	at 26	6.5	7.1	nd	nd	nd	nd	nd
2	Bm	0-5	7.2	7.8	0.02	0.88	23.3	2.8	20.3
	Cca	at 5	7.4	7.9	0.02	0.12	36.0	0.77	11.8
3	L-H	6-0	5.8	6.2	0.03	1.0	58.0	9.1	64.7
	Ck1	0-17	7.2	7.8	0.07	0.21	29.9	3.1	16.5
	Ck2	at 17	7.6	8.2	0.03	0.13	29.1	2.9	17.4
4	L-H	6-0	3.6	4.0	0.05	3.3	16.6	4.4	86.8
	Ae1	0-3	4.0	4.6	0.05	0.27	5.5	1.9	15.8
	Bm	3-18	5.8	6.6	0.08	0.21	5.7	1.3	12.7
	Ae2	18-26	5.6	6.2	0.06	0.13	5.7	2.2	8.9
	Bt	26-39	6.8	7.4	0.05	0.23	21.1	6.4	16.5
	Cca	at 39	7.4	8.0	nd	nd	nd	nd	nd
7	L-H	2-0	5.3	5.8	0.03	3.5	27.3	6.8	57.8
	Ae1	0-3	5.1	5.8	0.04	1.3	7.9	2.4	16.8
	Bm	3-8	5.3	5.8	0.06	0.77	7.5	1.9	19.7
	Ae2	8-11	4.7	5.4	0.06	0.29	8.0	2.3	12.7
	Bt	11-36	6.9	7.1	0.08	0.46	27.3	4.7	20.3
	Cca	at 36	7.3	7.6	nd	nd	nd	nd	nd

[1]meq/100 g - milliequivalents/100 gm soil, [2]CEC-cation exchange capacity, [3]OC - organic carbon, [4]FC - fine clay (<0.0002 mm diam.), [5]CF - coarse fragments (>2mm diam.) (field estimate), [6]nd - not determined, [7]gv-gravelly, vgv-very gravelly, [8]Gv - gravel.

[3] OC %	$CaCO_3$ equiv. %	Mechanical analysis % from fract < 2 mm diam. sand	silt	clay	[4] FC	[5] %CF	Texture Lab det	Field est	Free Fe + Al %
19.2	nd[6]	-	-	-	-	-	-	-	nd
2.2	nd	24	67	9	2	10	SiL	SiL	nd
0.83	nd	25	73	2	0	10	SiL	SiL	0.10
0.51	nd	33	60	7	3	60	SiL	vgv[7] SiL	nd
3.0	nd	32	47	21	15	70	L	vgv CL	nd
nd	5.9	62	34	4	2	90	SL	vgv L	nd
2.5	1.6	40	56	4	1	30	SiL	gvL	nd
0.81	53.2	nd	nd	nd	nd	100	nd	Gv[8]	nd
24.0	nd	-	-	-	-	-	-	-	nd
4.0	12.7	33	56	11	5	0	SiL	L	nd
nd	9.0	21	63	16	7	0	SiL	SiL	nd
44.2	nd	-	-	-	-	-	-	-	nd
2.4	nd	22	69	9	3	20	SiL	SiL	nd
1.7	nd	24	70	6	0	20	SiL	SiL	0.25
nd	nd	27	62	11	3	60	SiL	vgv SiL	nd
nd	nd	27	50	23	15	60	SiL-L	vgv CL	nd
nd	41.6	39	52	9	4	80	SiL	vgv SL	nd
30.2	nd	-	-	-	-	-	-	-	nd
2.8	nd	13	70	17	4	10	SiL	SiL	nd
2.0	nd	13	70	17	5	10	SiL	SiL	0.37
nd	nd	17	69	14	3	20	SiL	SiL	nd
nd	nd	8	60	32	17	20	SiCL	SiCL	nd
nd	7.1	12	61	27	12	30	SiL-SiCL	gv SiL	nd

TABLE 4.
Chemical and Physical Analyses of Soil Samples from Kananaskis Lakes Park (continued)

Map Unit	Horizon	Depth (cm)	pH $CaCl_2$	pH H_2O	Exchangeable Cations [1] meq/100 g				[2]CEC meq/100 g
					Na	K	Ca	Mg	
11	L-H	3-0	6.2	6.6	0.17	2.8	66.3	8.4	67.6
	Ckgj	0-50	7.4	8.0	0.05	0.09	28.0	2.7	16.4
	Ckg	at 50	7.4	7.9	0.04	0.09	23.0	3.3	17.9
12	L-H	3-0	5.7	5.7	0.02	2.8	32.0	3.6	46.3
	Ae	0-3	4.8	5.3	0.02	0.53	8.0	1.5	12.6
	AB	3-8	4.4	5.0	0.07	0.21	6.9	1.5	15.3
	Bt	8-17	5.6	5.7	0.02	0.22	16.1	3.0	19.4
	Cca1	17-45	7.1	7.4	nd	nd	nd	nd	nd
	Cca2	45-73	7.3	7.5	nd	nd	nd	nd	nd
	Ccag	at 73	7.3	7.6	nd	nd	nd	nd	nd
15	Ah	0-12	6.4	7.0	0.07	0.75	45.2	6.1	51.5
	Bm	12-46	6.4	7.2	0.01	0.12	7.3	1.3	7.9
	Cca	at 46	7.6	8.0	nd	nd	nd	nd	nd

TABLE 5.
Physical Analyses of Selected Map Units[1]

Map Unit	Depth (cm)	Field Moisture %	Mechanical Analysis: Percentage Passing Sieve 1 in	3/4 in	5/8 in	# 4 (4.7 mm)	# 10 (2.0 mm)	# 40 (0.42 mm)	# 200 (0.074 mm)	Percentage Smaller than 0.05 mm	0.005 mm	0.002 mm	0.001 mm	Liquid Limit	Plasticity Index
1	30-60	nd[3]	80	70	68	53	51	36	22	21	8	6	4	24	5
3	30-60	nd	100	100	100	100	100	100	83	67	21	15	12	31	7
4	30-60	3	93	90	88	73	67	57	35	34	17	11	9	20	3
4	60-90	nd	93	86	81	60	59	55	31	21	7	5	4	23	5
7	60-90	nd	94	94	94	92	91	84	74	66	33	25	24	34	13
7	90-120	22	100	100	100	100	100	99	98	92	36	23	16	31	6
12	45-75	nd	100	100	100	100	100	97	64	41	15	12	11	26	5

[1]Map Units developed on similar parent material: 1, 2 and 4; 3, 8 and 11; 7 and 14; 15 and 16.

[2]These values are obtained from charts worked out by the Highways Testing Laboratory, Alberta Transportation.

[3]nd - not determined.

[3] OC %	$CaCO_3$ eqiv. %	Mechanical analysis % from fract <2 mm diam. sand	silt	clay	[4]FC	[5] %CF	Texture Lab det	Field est	Free Fe + Al %
24.5	nd	-	-	-	-	-	-	-	nd
5.5	8.3	36	50	14	5	0	SiL-L	FSL	nd
nd	7.1	32	52	16	6	0	SiL	FSL	nd
13.9	nd	-	-	-	-	-	-	-	nd
2.6	nd	14	74	12	4	0	SiL	SiL	nd
1.9	nd	26	56	18	6	0	SiL	SiL	nd
3.1	nd	33	43	24	10	0	L	SiL	nd
nd	26.1	53	40	7	3	10	SL	CS	nd
nd	21.6	46	49	5	5	0	SL	FSL	nd
nd	28.7	47	42	11	5	0	L	VCS	nd
10.1	nd	30	53	17	4	10	SiL	L	nd
1.0	nd	30	57	13	6	40	SiL	gv L	nd
nd	41.6	24	59	17	9	60	SiL	vgv L	nd

Optimum Moisture [2] %	Maximum Dry Density [2] lb/ft^3	Classification AASHO	Unified	USDA
17	106	A-1-b(0)	SMd-SC	SL
25	95	A-4(8)	ML	SiL
14	113	A-2-4(0)	SMd	SL
16	110	A-2-4(0)	SMd-SC	L
21	101	A-6(9)	CL	CL
26	94	A-4(8)	ML	SiL
20	101.5	A-4(6)	CL-ML	SL

TABLE 6.
Soil limitations for primitive camping areas[1]

Map Symbol[2]	Degree of Limitation		
	None to Slight	Moderate	Severe
1/b2, 1/C2, 1/c2			
1/c3, 1/c4, 1/D2		Slip	
1/d2, 1/d3, 1/d4			
1/e2, 1/e3, 1/e4		Slope Er Slip	
1/f3, 1/f4			
1/g4		Slip	Slope Er
2/c4, 2/d4		Slip	
2/f4		Slope Er Slip	
2/g3, 2/G4, 2/g4		Slip	Slope Er
2/G5			
3/b0, 3/b3, 3/c0		Slip	Flood
4/C2, 4/c2, 4/c3			
4/C4, 4/d2, 4/d3			
4/d4, 4/d5, 4/e2		Slip	
4/E3, 4/e3, 4/e4			
4/e5			
4/f1, 4/f2, 4/f3		Slope Er Slip	
4/F4, 4/f4, 4/f5			
4/g3, 4/G4, 4/g4		Slip	Slope Er
4/G5			

TABLE 6.
Soil limitations for primitive camping areas[1] (continued)

Map Symbol[2]	Degree of Limitation None to Slight	Moderate	Severe
7/f1		Slope Er Slip	
8/B0 8/C0 8/e0		Slip	Flood
9/a0 9/b0			Wet Flood
10/b4 10/b5			Flood
11/b0 11/c1		Wet Slip	Flood
12/c0 12/c1		Slip	
13/a0 13/a1 13/a2			
13/a3 13/B0 13/b1		Slip	Wet Org Surf
13/b4 13/c0 13/C1			
13/C2 13/d1 13/e4			
13/F0		Slope Er Slip	Wet Org Surf
14/a0		Slip	Wet
15/e3		Slip	
16/c3		Slip	Wet
M/a0 M/E0			Org Wet
TM/C0			Org Wet
H/a0 H/C0			Org Wet
TH/a0 TH/b0			
TH/C0 TH/D0			Org Wet
TH/E0			
TH/F0		Slope	Org Wet

[1]Surface stoniness was not considered in determining these ratings.

[2]For explanation, see section entitled "SOILS."

ABBREVIATIONS
Er – Erosion hazard
Flood – Flooding hazard (overflow)
Org – Organic soil
Org Surf – Organic surface layer >15 cm thick
Slip – Slippery or sticky when wet
Slope – Excessive slope
Wet – Seasonally high groundwater table or surface ponding

TABLE 7.
Soil limitations for fully serviced campgrounds[1]

Map Symbol[2]	Degree of Limitation None to Slight	Moderate	Severe
1/b2, 1/C2, 1/c2			
1/c3, 1/c4, 1/D2		Slip	
1/d2, 1/d3, 1/d4			
1/e2, 1/e3, 1/e4		Slope Er Slip	
1/f3, 1/f4, 1/g4		Slip	Slope Er
2/c4, 2/d4		Slip	
2/f4, 2/g3, 2/G4		Slip	Slope Er
2/g4, 2/G5			
3/b0, 3/b3, 3/c0		Slip	Flood
4/C2, 4/c2, 4/c3			
4/C4, 4/d2, 4/d3		Slip	
4/d4, 4/d5			
4/e2, 4/E3, 4/e3		Slope Er Slip	
4/e4, 4/e5			
4/f1, 4/f2, 4/f3			
4/F4, 4/f4, 4/f5		Slip	Slope Er
4/g3, 4/G4, 4/g4			
4/G5			
7/f1		Slip	Slope Er
8/B0, 8/C0		Slip	Flood
8/e0		Slope Er Slip	Flood
9/a0, 9/b0			Wet Flood
10/b4, 10/b5			Flood
11/b0, 11/c1		Wet Slip	Flood

TABLE 7.
Soil limitations for fully serviced campgrounds (continued)

Map Symbol[2]	Degree of Limitation None to Slight	Moderate	Severe
12/c0 12/c1		Slip	
13/a0 13/a1 13/a2			
13/a3 13/B0 13/b1		Slip	Wet Org Surf
13/b4 13/c0 13/C1			
13/C2 13/d1		Slope Er Slip	Wet Org Surf
13/e4			
13/F0		Slip	Wet Org Surf Slope
14/a0		Slip	Wet
15/e3		Slope Er Slip	
16/c3		Slip	Wet
M/a0			Org Wet
M/E0		Slope	Org Wet
TM/C0			Org Wet
H/a0 H/C0			Org Wet
TH/a0 TH/b0			Org Wet
TH/C0 TH/D0			
TH/E0		Slope	Org Wet
TH/F0			Org Wet Slope

[1]Surface Stoniness was not considered in determining these ratings.

[2]For explantion, see section entitled "SOILS."

ABBREVIATIONS

Er – Erosion hazard
Flood – Flooding hazard (overflow)
Org Surf – Organic surface layer >15 cm thick.
Slope – Excessive slope
Wet – Seasonally high groundwater table or surface ponding

TABLE 8.
Soil limitations for picnic areas[1]

Map Symbol[2]	Degree of Limitation None to Slight	Moderate	Severe
1/b2 1/C2 1/c2			
1/c3 1/c4 1/D2		Slip	
1/d2 1/d3 1/d4			
1/e2 1/e3 1/e4		Slope Er Slip	
1/f3 1/f4 1/g4		Slip	Slope Er
2/c4 2/d4		Slip	
2/f4 2/g3 2/G4 2/g4 2/G5		Slip	Slope Er
3/b0 3/b3 3/c0		Slip Flood	
4/C2 4/c2 4/c3			
4/C4 4/d2 4/d3		Slip	
4/d4 4/d5			
4/e2 4/E3 4/e3		Slope Er Slip	
4/e4 4/e5			
4/f1 4/f2 4/f3			
4/F4 4/f4 4/f5 4/g3 4/G4 4/g4		Slip	Slope Er
4/G5			
7/f1		Slip	Slope Er
8/B0 8/C0		Flood Slip	
8/e0		Slope Er Flood	
9/a0 9/b0		Flood	Wet
10/b4 10/b5		Flood	
11/b0 11/c1		Wet, Slip Flood	

TABLE 8.
Soil limitations for picnic areas (continued)

Map Symbol[2]	Degree of Limitation None to Slight	Moderate	Severe
12/c0 12/c1		Slip	
13/a0 13/a1 13/a2			
13/a3 13/B0 13/b1		Slip	Wet Org Surf
13/b4 13/c0 13/C1			
13/C2 13/d1			
13/e4		Slope Er Slip	Wet Org Surf
13/F0		Slip	Wet Org Surf Slope
14/a0		Slip	Wet
15/e3		Slope Er Slip	
16/c3		Slip	Wet
M/a0			Org Wet
M/E0		Slope	Org Wet
TM/C0			Org Wet
H/a0 H/C0			Org Wet
TH/a0 TH/b0			Org Wet
TH/C0 TH/D0			
TH/E0		Slope	Org Wet
TH/F0			Org Wet Slope

[1] Surface stoniness was not considered in determining these ratings.

[2] For explanation see section entitled "SOILS."

ABBREVIATIONS

Er – Erosion hazard
Flood – Flooding hazard (overflow)
Org – Organic soil
Org Surf – Organic surface layer >15 cm thick
Slip – Slippery or sticky when wet
Slope – Excessive slope
Wet – Seasonally high groundwater table or surface ponding

TABLE 9.
Soil limitations for paths[1]

Map Symbol[2]	Degree of Limitation None to Slight	Moderate	Severe
1/b2 1/C2 1/c2			
1/c3 1/c4 1/D2		Slip	
1/d2 1/d3 1/d4		Slope Er Slip	
1/e2 1/e3 1/e4			
1/f3 1/f4 1/g4		Slip	Slope Er
2/c4 2/d4		Slip	
2/f4 2/g3 2/G4		Slip	Slope Er
2/g4 2/G5			
3/b0 3/b3 3/c0		Slip Flood	
4/C2 4/c2 4/c3			
4/C4 4/d2 4/d3		Slip	
4/d4 4/d5			
4/e2 4/E3 4/e3		Slope Er Slip	
4/e4 4/e5			
4/f1 4/f2 4/f3			
4/F4 4/f4 4/f5		Slip	Slope Er
4/g3 4/G4 4/g4			
4/G5			
7/f1		Slip	Slope Er
8/B0 8/C0		Slip	Flood
8/e0		Slope Er Slip	Flood
9/a0 9/b0			Wet Flood
10/b4 10/b5		Flood	

TABLE 9.
Soil limitations for paths (continued)

Map Symbol[2]	Degree of Limitation: None to Slight	Moderate	Severe
11/b0 11/c1		Wet Slip Flood	
12/c0 12/c1		Slip	
13/a0 13/a1 13/a2			
13/a3 13/B0 13/b1		Slip	Wet Org Surf
13/b4 13/c0 13/C1			
13/C2 13/d1			
13/e4		Slope Er Slip	Wet Org Surf
13/F0		Slip	Wet Org Surf Slope
14/a0		Slip	Wet
15/e3		Slope Er Slip	
16/c3		Slip	Wet
M/a0			Org Wet
M/E0		Slope	Org Wet
TM/C0			Org Wet
H/a0 H/C0			Org Wet
TH/a0 TH/b0			Org Wet
TH/C0 TH/D0			
TH/E0		Slope	Org Wet
TH/F0			Org Wet Slope

[1]Surface stoniness was not considered in determining these ratings.

[2]For explanation, see section entitled "SOILS."

ABBREVIATIONS
Er – Erosion hazard
Flood – Flooding hazard (overflow)
Org – Organic soil
Org Surf – Organic surface layer >15 cm thick
Slip – Slippery or sticky when wet
Slope – Excessive slope
Wet – Seasonally high groundwater table or surface ponding

TABLE 10.
Soil limitations for trails[1]

Map Symbol[2]	Degree of Limitation None to Slight	Moderate	Severe
1/b2, 1/C2, 1/c2			
1/c3, 1/c4, 1/D2		Slip	
1/d2, 1/d3, 1/d4			
1/e2, 1/e3, 1/e4		Slope Er Slip	
1/f3, 1/f4			
1/g4		Slip	Slope Er
2/c4, 2/d4		Slip	
2/f4		Slope Er Slip	
2/g3, 2/G4, 2/g4		Slip	Slope Er
2/G5			
3/b0, 3/b3, 3/c0		Slip Flood	
4/C2, 4/c2, 4/c3			
4/C4, 4/d2, 4/d3			
4/d4, 4/d5, 4/e2		Slip	
4/E3, 4/e3, 4/e4			
4/e5			
4/f1, 4/f2, 4/f3		Slope Er Slip	
4/F4, 4/f4, 4/f5			
4/g3, 4/G4, 4/g4		Slip	Slope Er
4/G5			

TABLE 10.
Soil limitations for trails (continued)

Map Symbol[2]	Degree of Limitation None to Slight	Moderate	Severe
7/f1		Slope Er Slip	
8/B0 8/C0 8/e0		Slip	Flood
9/a0 9/b0			Wet Flood
10/b4 10/b5		Flood	
11/b0 11/c1		Wet Slip Flood	
12/c0 12/c1		Slip	
13/a0 13/a1 13/a2			
13/a3 13/B0 13/b1		Slip	Wet Org Surf
13/b4 13/c0 13/C1			
13/C2 13/d1 13/e4			
13/F0		Slope Er Slip	Wet Org Surf
14/a0		Slip	Wet
15/e3		Slip	
16/c3		Slip	Wet
M/a0 M/E0			Org Wet
TM/C0			Org Wet
H/a0 H/C0			Org Wet
TH/a0 TH/b0			
TH/C0 TH/D0			Org Wet
TH/E0			
TH/F0		Slope	Org Wet

[1]Surface stoniness was not considered in determining these ratings.

[2]For explanation, see section entitled "SOILS."

ABBREVIATIONS

Er – Erosion hazard
Flood – Flooding hazard (overflow)
Org – Organic soil
Org Surf – Organic surface layer >15 cm thick
Slip – Slippery or sticky when wet
Slope – Excessive slope
Wet – Seasonally high groundwater table or surface ponding

TABLE 11.
Soil limitations for lawns and landscaping[1]

Map Symbol[2]	Degree of Limitation None to Slight	Moderate	Severe
1/b2, 1/C2, 1/c2			
1/c3, 1/c4, 1/D2		Thin Ah	
1/d2, 1/d3, 1/d4			
1/e2, 1/e3, 1/e4		Thin Ah Slope Er	
1/f3, 1/f4, 1/g4			Slope Er Thin Ah
2/c4, 2/d4		Thin Ah Lime	R Perm
2/f4, 2/g3, 2/G4, 2/g4, 2/G5			Slope Er R Perm
3/b0, 3/b3, 3/c0		Thin Ah Lime Flood	
4/C2, 4/c2, 4/c3			
4/C4, 4/d2, 4/d3, 4/d4, 4/d5		Thin Ah	
4/e2, 4/E3, 4/e3, 4/e4, 4/e5		Thin Ah Slope Er	
4/f1, 4/f2, 4/f3			
4/F4, 4/f4, 4/f5		Thin Ah	Slope Er
4/g3, 4/G4, 4/g4, 4/G5			
7/f1		Thin Ah	Slope Er
8/B0, 8/C0, 8/e0		Thin Ah Lime Flood	
9/a0, 9/b0		Flood Thin Ah	Wet
10/b4, 10/b5		Flood	R Perm Thin Ah Lime

TABLE 11.
Soil limitations for lawns and landscaping (continued)

Map Symbol[2]	Degree of Limitation None to Slight	Moderate	Severe
11/b0 11/c1		Wet Thin Ah Lime	
12/c0 12/c1		Thin Ah	
13/a0 13/a1 13/a2			
13/a3 13/B0 13/b1		Thin Ah	Wet Org Surf
13/b4 13/c0 13/C1			
13/C2 13/d1			
13/e4		Slope Er Thin Ah	Wet Org Surf
13/F0		Thin Ah	Wet Org Surf Slope
14/a0			Wet
15/e3		Slope Er	
16/c3			Wet
M/a0		Thin Ah	Org Wet
M/E0		Slope Thin Ah	Org Wet
TM/C0		Thin Ah	Org Wet
H/a0 H/C0		Thin Ah	Org Wet
TH/a0 TH/b0		Thin Ah	Org Wet
TH/C0 TH/D0			
TH/E0		Slope Thin Ah	Org Wet
TH/F0		Thin Ah	Org Wet Slope

[1]Surface stoniness was not considered in determining these ratings.

[2]For explanation, see section entitled "SOILS."

ABBREVIATIONS

Er – Erosion hazard
Flood – Flooding hazard (overflow)
Lime – High lime content (soil nutrient imbalance)
Org – Organic soil
Org Surf – Organic surface layer >15 cm thick
R Perm – Rapid permeability (droughtiness)
Slope – Excessive slope
Thin Ah – Thin or no Ah horizon
Wet – Seasonally high groundwater table or surface ponding

TABLE 12.
Soil limitations for buildings with basements[1]

Map Symbol[2]	Degree of Limitation			
	None to Slight	Moderate	Severe	Unsuitable
1/b2 1/C2 1/c2				
1/c3 1/c4 1/D2	NL			
1/d2 1/d3 1/d4				
1/e2 1/e3 1/e4		Slope		
1/f3 1/f4 1/g4			Slope	
2/c4 2/d4	NL			
2/f4 2/g3 2/G4			Slope	
2/g4 2/G5				
3/b0 3/b3 3/c0		M Sh-Sw	Flood Frost	
4/C2 4/c2 4/c3				
4/C4 4/d2 4/d3	NL			
4/d4 4/d5				

May Symbol[2]	Degree of Limitation			
	None to Slight	Moderate	Severe	Unsuitable
4/e2 4/E3 4/e3				
4/e4 4/e5		Slope		
4/f1 4/f2 4/f3				
4/F4 4/f4 4/f5			Slope	
4/g3 4/G4 4/g4				
4/G5				
7/f1		M Sh-Sw	Slope Frost	
8/B0 8/C0		M Sh-Sw	Flood Frost	
8/e0		Slope M Sh-Sw	Flood Frost	
9/a0 9/b0			Wet Flood	
10/b4 10/b5			Flood	
11/b0 11/c1		M Sh-Sw	Flood Wet Frost	

TABLE 12.
Soil limitations for buildings with basements (continued)

Map Symbol[2]	None to Slight	Moderate	Severe	Unsuitable
12 c0, 12 c1		M Sh-Sw	Frost	
13 a0, 13 a1, 13 a2				
13 a3, 13 B0, 13 b1				
13 b4, 13 c0, 13 C1		M Sh-Sw	Wet Frost	
13 C2, 13 d1				
13 e4		Slope M Sh-Sw	Wet Frost	
13 F0		M Sh-Sw	Wet Slope Frost	
14 a0		M Sh-Sw	Wet Frost	
15 e3		Slope M Sh-Sw	Frost	
16 c3		M Sh-Sw	Wet Frost	
M a0			Sh-Sw Frost	Org Wet
M E0		Slope	Sh-Sw Frost	Org Wet
TM C0			Sh-Sw Frost	Org Wet
H a0, H C0			Sh-Sw Frost	Org Wet
TH a0, TH b0			Sh-Sw Frost	Org Wet
TH C0, TH D0				
TH E0		Slope	Sh-Sw Frost	Org Wet
TH F0			Sh-Sw Frost Slope	Org Wet

[1]Surface stoniness was not considered in determining these ratings.

[2]For explanation, see section entitled "SOILS."

ABBREVIATIONS

Flood – Flooding hazard (overflow)
Frost – Susceptibility to frost-heave
M Sh-Sw – moderate shrink-swell potential
NL – No limitations
Org – Organic soil
Sh-Sw – High shrink-swell potential
Slope – Excessive slope
Wet – Seasonally high ground-water table or surface ponding

TABLE 13.
Soil limitations for buildings without basements[1]

Map Symbol[2]	Degree of Limitation: None to Slight	Moderate	Severe	Unsuitable
1/b2 1/C2 1/c2 1/c3 1/c4 1/D2 1/d2 1/d3 1/d4	NL			
1/e2 1/e3 1/e4		Slope		
1/f3 1/f4 1/g4			Slope	
2/c4 2/d4	NL			
2/f4 2/g3 2/G4 2/g4 2/G5			Slope	
3/b0 3/b3 3/c0			Flood	
4/C2 4/c2 4/c3 4/C4 4/d2 4/d3 4/d4 4/d5	NL			
4/e2 4/E3 4/e3 4/e4 4/e5		Slope		
4/f1 4/f2 4/f3 4/F4 4/f4 4/f5 4/g3 4/G4 4/g4 4/G5			Slope	
7/f1			Slope	

TABLE 13.
Soil limitations for buildings without basements (continued)

Map Symbol[2]	Degree of Limitation: None to Slight	Moderate	Severe	Unsuitable
8/B0 8/C0			Flood	
8/e0		Slope	Flood	
9/a0 9/b0			Wet Flood	
10/b4 10/b5			Flood	
11/b0 11/c1		Wet	Flood	
12/c0 12/c1	NL			
13/a0 13/a1 13/a2				
13/a3 13/B0 13/b1				
13/b4 13/c0 13/C1			Wet	
13/C2 13/d1				
13/e4		Slope	Wet	
13/F0			Wet Slope	
14/a0			Wet	
15/e3		Slope		
16/c3			Wet	
M/a0				Org Wet
M/E0		Slope		Org Wet
TM/C0				Org Wet
H/a0 H/C0				Org Wet
TH/a0 TH/b0				Org Wet
TH/C0 TH/D0				
TH/E0		Slope		Org Wet
TH/F0			Slope	Org Wet

[1]Surface stoniness was not considered in determining these ratings.

[2]For explanation, see section entitled "SOILS."

ABBREVIATIONS
Flood – Flooding hazard (overflow)
NL – No limitations
Org – Organic soil
Slope – Excessive slope
Wet – Seasonally high groundwater table or surface ponding

TABLE 14.
Soil limitations for septic tank absorption fields

Map Symbol[1]	None to Slight	Moderate	Severe	Unsuitable
1/b2, 1/C2, 1/c2				
1/c3, 1/c4, 1/D2	NL			
1/d2, 1/d3, 1/d4				
1/e2, 1/e3, 1/e4		Slope		
1/f3, 1/f4, 1/g4			Slope	
2/c4, 2/d4			R Perm GW	
2/f4, 2/g3, 2/G4 2/g4, 2/G5			Slope R Perm GW	
3/b0, 3/b3, 3/c0			R. Perm GW Flood	
4/C2, 4/c2, 4/c3				
4/C4, 4/d2, 4/d3 4/d4, 4/d5	NL			
4/e2, 4/E3, 4/e3		Slope		
4/e4, 4/e5		Slope		
4/f1, 4/f2, 4/f3 4/F4, 4/f4, 4/f5 4/g3, 4/G4, 4/g4 4/G5			Slope	
7/f1				Slope
8/B0, 8/C0				Flood R Perm GW
8/e0		Slope		Flood R Perm GW
9/a0, 9/b0				Wet Flood GW
10/b4, 10/b5				Flood R Perm GW
11/b0, 11/c1				Flood Wet GW

TABLE 14.
Soil limitations for septic tank absorption fields (continued)

Map Symbol[1]	Degree of Limitation			
	None to Slight	Moderate	Severe	Unsuitable
12/c0 12/c1			R Perm GW	
13/a0 13/a1 13/a2 13/a3 13/B0 13/b1 13/b4 13/c0 13/C1 13/C2 13/d1			Wet GW	
13/e4		Slope	Wet GW	
13/F0			Wet GW Slope	
14/a0			Wet GW	
15/e3		Slope		
16/c3			Wet GW	
M/a0				Org Wet GW
M/E0		Slope		Org Wet GW
TM/C0				Org Wet GW
H/a0 H/C0				Org Wet GW
TH/a0 TH/b0 TH/C0 TH/D0				Org Wet GW
TH/E0		Slope		Org Wet GW
TH/F0			Slope	Org Wet GW

[1]For explanation, see section entiltled "SOILS."

ABBREVIATIONS
Flood - Flooding hazard (overflow)
GW - Groundwater contamination hazard
NL - No limitations
Org - Organic soil
R Perm - Rapid permeability
Slope - Excessive slope
Wet - Seasonally high groundwater table or surface ponding

TABLE 15.
Soil limitations for trench-type sanitary landfills[1]

Map Symbol[2]	Degree of Limitation: None to Slight	Moderate	Severe	Unsuitable
1/b2 1/C2 1/c2 1/c3 1/c4 1/D2 1/d2 1/d3 1/d4 1/e2 1/e3 1/e4	NL			
1/f3 1/f4		Slope		
1/g4			Slope	
2/c4 2/d4			R Perm GW	
2/f4			R Perm GW Slope	
2/g3 2/G4 2/g4 2/G5			Slope R Perm GW	
3/b0 3/b3 3/c0			R Perm GW Flood	
4/C2 4/c2 4/c3 4/C4 4/d2 4/d3 4/d4 4/d5 4/e2 4/E3 4/e3 4/e4	NL			
4/e5				
4/f1 4/f2 4/f3 4/F4 4/f4 4/f5		Slope		
4/g3 4/G4 4/g4			Slope	

TABLE 15.
Soil limitations for trench-type sanitary landfills (continued)

Map Symbol[2]	Degree of Limitation: None to Slight	Moderate	Severe	Unsuitable
4 / G5			Slope	
7 / f1			Slope	
8 / B0	8 / C0	8 / e0		Flood R Perm GW
9 / a0	9 / b0			Wet Flood GW
10 / b4	10 / b5			Flood R Perm GW
11 / b0	11 / c1			Flood Wet GW
12 / c0	12 / c1			R Perm GW
13 / a0	13 / a1	13 / a2		
13 / a3	13 / B0	13 / b1		Wet GW
13 / b4	13 / c0	13 / C1		
13 / C2	13 / d1	13 / e4		
13 / F0		Slope		Wet GW
14 / a0				Wet GW
15 / e3		NL		
16 / c3				Wet GW
M / a0	M / E0			Org Wet GW
TM / C0				Org Wet GW
H / a0	H / C0			Org Wet GW
TH / a0	TH / b0			
TH / C0	TH / D0			Org Wet GW
TH / E0				
TH / F0		Slope		Org Wet GW

[1]Surface stoniness was not considered in determining these ratings.

[2]For explanation, see section entitled "SOILS."

ABBREVIATIONS

Flood - Flooding hazard (overflow)
GW - Groundwater contamination hazard
NL - No limitations
Org - Organic soil
R Perm - Rapid permeability
Slope - Excessive slope
Wet - Seasonally high groundwater table or surface ponding

TABLE 16.
Soil limitations for road location[1]

Map Symbol[2]	Degree of Limitation: None to Slight	Moderate	Severe
1/b2 1/C2 1/c2			
1/c3 1/c4 1/D2	NL		
1/d2 1/d3 1/d4			
1/e2 1/e3 1/e4		Slope	
1/f3 1/f4 1/g4			Slope
2/c4 2/d4	NL		
2/f4 2/g3 2/G4			Slope
2/g4 2/G5			
3/b0 3/b3 3/c0		M Sh-Sw	Flood Frost
4/C2 4/c2 4/c3			
4/C4 4/d2 4/d3	NL		
4/d4 4/d5			
4/e2 4/E3 4/e3		Slope	
4/e4 4/e5			
4/f1 4/f2 4/f3			
4/F4 4/f4 4/f5			Slope
4/g3 4/G4 4/g4			
4/G5			
7/f1		M Sh-Sw	Slope Frost
8/B0 8/C0		M Sh-Sw	Flood Frost
8/e0		Slope M Sh-Sw	Flood Frost
9/a0 9/b0			Wet Flood
10/b4 10/b5			Flood
11/b0 11/c1		Wet M Sh-Sw	Flood Frost

TABLE 16.
Soil limitations for road location (continued)

Map Symbol[2]	Degree of Limitation: None to Slight	Moderate	Severe
12/c0 12/c1		M Sh-Sw	Frost
13/a0 13/a1 13/a2			
13/a3 13/B0 13/b1		M Sh-Sw	Wet Frost
13/b4 13/c0 13/C1			
13/C2 13/d1			
13/e4		Slope M Sh-Sw	Wet Frost
13/F0		M Sh-Sw	Wet Slope Frost
14/a0		M Sh-Sw	Wet Frost
15/e3		Slope M Sh-Sw	Frost
16/c3		M Sh-Sw	Wet Frost
M/a0			Org Wet Sh-Sw
M/E0		Slope	Org Wet Sh-Sw
TM/C0			Org Wet Sh-Sw
H/a0 H/C0			Org Wet Sh-Sw
TH/a0 TH/b0			Org Wet Sh-Sw
TH/C0 TH/D0			
TH/E0		Slope	Org Wet Sh-Sw
TH/F0			Org Wet Slope

[1]Surface stoniness was not considered in determining these ratings.

[2]For explanation, see section entitled "SOILS."

ABBREVIATIONS

Flood – Flooding hazard (overflow)
Frost – Susceptibility to frost heave
M Sh-Sw – Moderate shrink-swell potential
NL – No limitations
Org – Organic Soil
Sh-Sw – High shrink-swell potential
Slope – Excessive slope
Wet – Seasonally high ground-water table or surface ponding

TABLE 17.
Soil suitability for source of roadfill[1]

Map Symbol[2]	Degree of Suitability			
	Good	Fair	Poor	Unsuitable
1/b2 1/C2 1/c2 1/c3 1/c4 1/D2 1/d2 1/d3 1/d4 1/e2 1/e3 1/e4	NL			
1/f3 1/f4		Slope		
1/g4			Slope	
2/c4 2/d4	NL			
2/f4		Slope		
2/g3 2/G4 2/g4 2/G5			Slope	
3/b0 3/b3 3/c0		M Sh-Sw	Frost	

Map Symbol[2]	Degree of Suitability			
	Good	Fair	Poor	Unsuitable
4/C2 4/c2 4/c3 4/C4 4/d2 4/d3 4/d4 4/d5 4/e2 4/E3 4/e3 4/e4	NL			
4/e5		Slope		
4/f1 4/f2 4/f3 4/F4 4/f4 4/f5		Slope		
4/g3 4/G4 4/g4 4/G5			Slope	
7/f1		Slope M Sh-Sw	Frost	

TABLE 17.
Soil suitability for source of roadfill (continued)

Map Symbol[2]	Degree of Suitability			
	Good	Fair	Poor	Unsuitable
8/B0 8/C0 8/e0		M Sh-Sw	Frost	
9/a0 9/b0			Wet	
10/b4 10/b5	NL			
11/b0 11/c1		Wet M Sh-Sw	Frost	
12/c0 12/c1		M Sh-Sw	Frost	
13/a0 13/a1 13/a2 13/a3 13/B0 13/b1 13/b4 13/c0 13/C1 13/C2 13/d1 13/e4		M Sh-Sw	Wet Frost	
13/F0		Slope M Sh-Sw	Wet Frost	
14/a0		M Sh-Sw	Wet Frost	
15/e3		M Sh-Sw	Frost	
16/c3		M Sh-Sw	Wet Frost	
M/a0 M/E0			Sh-Sw Frost	Org Wet
TM/C0			Sh-Sw Frost	Org Wet
H/a0 H/C0			Sh-Sw Frost	Org Wet
TH/a0 TH/b0 TH/C0 TH/D0 TH/E0			Sh-Sw Frost	Org Wet
TH/F0		Slope	Sh-Sw Frost	Org Wet

[1]Surface stoniness was not considered in determining these ratings.

[2]For explanation, see section entitled "SOILS."

ABBREVIATIONS

Frost – Susceptibility to frost heave
M Sh-Sw – Moderate shrink-swell potential
NL – No limitations
Org – Organic soil
Sh-Sw – High shrink-swell potential
Slope – Excessive slope
Wet – Seasonally high groundwater table or surface ponding

TABLE 18.
Soil suitability for source of sand or gravel

Map Symbol[1]	Degree of Suitability				Map Symbol[1]	Degree of Suitability			
	Good	Fair	Poor	Unsuitable		Good	Fair	Poor	Unsuitable
1/b2 1/C2 1/c2					4/C2 4/c2 4/c3				
1/c3 1/c4 1/D2					4/C4 4/d2 4/d3				
1/d2 1/d3 1/d4			Text		4/d4 4/d5 4/e2				
1/e2 1/e3 1/e4					4/E3 4/e3 4/e4			Text	
1/f3 1/f4 1/g4					4/e5 4/f1 4/f2				
2/c4 2/d4 2/f4					4/f3 4/F4 4/f4				
2/g3 2/G4 2/g4		Text			4/f5 4/g3 4/G4				
2/G5					4/g4 4/G5				
3/b0 3/b3 3/c0		Flood			7/f1				Text

TABLE 18.
Soil suitability for source of sand or gravel (continued)

Map Symbol[1]	Degree of Suitability			
	Good	Fair	Poor	Unsuitable
8/B0 8/C0 8/e0			Flood	
9/a0 9/b0			Wet Flood	
10/b4 10/b5			Flood	
11/b0 11/c1			Flood	
12/c0 12/c1	NL			
13/a0 13/a1 13/a2				
13/a3 13/B0 13/b1			Wet	Text
13/b4 13/c0 13/C1				
13/C2 13/d1 13/e4				
13/F0			Wet	Text
14/a0			Wet	Text
15/e3				Text
16/c3			Wet	Text
M/a0 M/E0			Wet	Org Text
TM/C0			Wet	Org Text
H/a0 H/C0			Wet	Org Text
TH/a0 TH/b0 TH/C0			Wet	Org Text
TH/D0 TH/E0 TH/F0				

[1]For explanation, see section entitled, "SOILS."

ABBREVIATIONS

Flood – Flooding hazard (overflow)
NL – No limitations
Org – Organic soil
Text – Unsuitable texture
Wet – Seasonally high groundwater table or surface ponding

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APPENDIX

SOIL FORMATION

Soil is continuous over the land surface of the earth, except for the steep and rugged mountain peaks, the lands of ice and snow (Simonson, 1957), and in areas where it has been removed by man's activities. Soils may be regarded as products of their environment (Clayton *et al.*, 1977). They are not static, but dynamic, and will change with modifications in the environment. The most important factors in determining the kinds of soils that develop are climate, vegetation, organisms, relief, time, and parent material. Because of these factors, the soils that have developed are different from one another, both locally and regionally. The differences may be small or large, depending upon the magnitude of the factors involved, particularly those of climate and parent material.

IDENTIFICATION OF SOIL PROFILES AND HORIZONS

The soil profile as viewed in vertical cross-section is a succession of layers or horizons approximately parallel to the land surface, and extending from the surface of the soil down into the underlying, and relatively unchanged, geological material (Clayton *et al.*, 1977). These horizons reflect the formation of soil from the original parent material, involving the processes of physical breakdown or weathering of rock fragments, the chemical weathering or alteration and solution of rock and mineral particles, biological activities including the growth of plants and decomposition of plant material, and the production of humus (soil organic matter) by the work of macro and micro soil organisms. These processes involve changes in material and transference from one part of the soil to another, and the development of soil structure. Each soil horizon differs from adjacent genetically related layers in properties such as color, structure, texture, consistence, and chemical, biological, and mineralogical composition.

The A horizon, the uppermost layer in the mineral soil profile, is usually the part of the soil in which organic matter is most plentiful. In soils formed under forest cover, the A horizon has been leached, both in suspension and in solution, of substances such as clay particles, organic matter, iron and aluminum oxides.

The B horizon, when present, lies immediately beneath the A, and the color is often transitional between that of the A and C horizons. The B frequently has more clay than either of the A or the C horizons, and may have a blocky or prismatic structure. Concentrations of iron or aluminum oxides, usually in combination with organic matter, mark the B horizons of some soils.

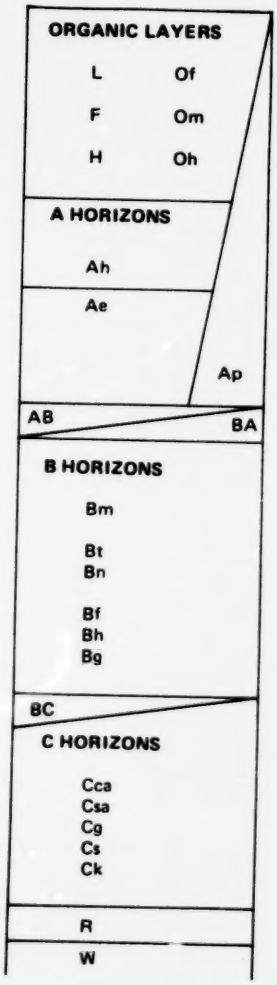
The C horizon is the deepest of the three major horizons, and constitutes the parent material of soils. It may have accumulated in place from the breakdown of hard rock, or it may have been moved to its present location by water, wind, or ice. The C is comparatively unaltered by soil-forming processes, except gleying; and the accumulation of calcium and magnesium carbonates, and water soluble salts. It is commonly lighter colored than the A or B horizons.

A particular soil is recognized by identifying the various layers or horizons that make up its profile. A system has been devised to facilitate this recognition (Clayton *et al.*, 1977) which involves recognizing major organic layers, master mineral horizons and layers, and further subdivision of these horizons by designation of features secondary or subordinate to those characteristics of the main horizons. See the Canadian System of Soil Classification (Canada Soil Survey Committee, 1978) for the comprehensive outline of the classification scheme, the official criteria for identification of horizons and layers, and for conventions regarding their use. Figure 2 gives more generalized definitions of the soil horizons, and the symbols used to designate them in profile descriptions. Table 19 gives a generalized outline of the Canadian soil classification system. Figure 3 gives diagrammatic horizon patterns of some representative soil profiles from the various orders.

TABLE 19
Outline of Canadian Soil Classification System (Canada Soil Survey Committee 1978)

ORDER	GREAT GROUP	DISTINGUISHING CHARACTERISTICS
Brunisolic (Sufficient development to exclude them from the Regosolic order, but lack degrees or kinds of development specified for other orders)	Melanic Brunisol	Ah >10 cm, pH >5.5
	Eutric Brunisol	Ah <10 cm, pH >5.5
	Sombric Brunisol	Ah >10 cm, pH <5.5
	Dystric Brunisol	Ah <10 cm, pH <5.5
Chernozemic (Surface horizons darkened by accumulation of organic matter from decomposition of xerophytic or mesophytic plants representative of grasslands or grassland-forest with associated plants)	Brown	Brownish Ah, subarid to semiarid climate
	Dark Brown	Dark brown Ah, semiarid climate
	Black	Black Ah, subhumid climate
	Dark Gray	Surface L-H, eluvial Ah, subhumid climate
Cryosolic (Permafrost within 1 m of surface, or 2 m if >1/3 of pedon strongly cryoturbated)	Turbic Cryosol	Mineral soil, cryoturbation, permafrost within 2 m of surface, usually patterned ground
	Static Cryosol	Mineral soil, no cryoturbation, permafrost within 1 m of surface
	Organic Cryosol	Organic soil, permafrost within 1 m of surface
Gleysolic (Features indicative of periodic or prolonged water saturation, and reducing conditions - mottline and gleying)	Humic Gleysol	Ah >10 cm no Bt
	Gleysol	Ah <10 cm no Bt
	Luvic Gleysol	Has a Btg, usually has an Ahe or an Aeg
Luvisolic (Light colored eluvial horizons - Ae, illuvial B horizons of silicate clay accumulation - Bt, developed under forest vegetation)	Gray Brown Luvisol	Forest mull Ah, Ae and Bt, MAST[1] >8° C
	Gray Luvisol	May or may not have Ah, has Ae and Bt, usually MAST <8° C.
Organic (Composed dominantly of organic materials, most are water saturated for prolonged periods)	Fibrisol	Dominantly fibric
	Mesisol	Dominantly mesic
	Humisol	Dominantly humic
	Folisol	Forest leaf litter over rock or fragmental material rarely water saturated
Podzolic (Accumulation in B horizons of amorphous material, composed mainly of humified organic matter combined in varying degrees with Al and Fe)	Humic Podzol	Bh ≥10 cm, OC[2] >1%, Fe <0.3%, OC[2]/Fe ≥20.
	Ferro-Humic Podzol	Bhf ≥10cm, OC[2] >5%, Fe + Al≥0.6% (0.4% for sands)
	Humo-Ferric Podzol	Bf or thin Bhf + Bf ≥10 cm, OC[2] = 0.5 - 5% Fe + Al ≥0.6% (0.4% for sands)
Regosolic (Development too weak to meet requirements of any other order)	Regosol	Ah <10 cm, Bm absent or <5 cm
	Humic Regosol	Ah ≥10 cm, Bm absent or <5 cm
Solonetzic (Solonetzic B horizon - Bn or Bnt - columnar or prismatic structure, hard to extremely hard when dry, exchangeable Ca/Na ≤10)	Solonetz	Lack a continuous Ae ≥2 cm
	Solodized Solonetz	Ae ≥2 cm, intact columnar Bnt or Bn
	Solod	Ae ≥2 cm, distinct AB or BA (disintegrating Bnt)

[1]MAST - mean annual soil temperature
[2]OC - organic carbon



L-F-H — well drained decomposing plant litter, primarily leaves, twigs, woody materials.
L - slightly decomposed, F - partly decomposed, H - well decomposed.

O — poorly drained decomposing peat, mainly mosses, rushes, woody materials.
Of - fibric - least decomposed; Om - mesic - moderately decomposed; Oh - humic - most highly decomposed.

A — Organic-mineral horizons at or near the surface.
Ah - dark colored, humus-rich horizon
Ae - light colored, eluviated horizon, characterized by removal of clay, iron, aluminium or organic matter, alone or in combination.
Ap - horizons disturbed by man's activities, that is, by cultivation, or pasturing, or both.

AB, BA — horizons transitional to A and B.

B — a mineral horizon differing from A and C by the following characteristics:
m - slightly altered by hydrolysis, oxidation, or solution or all three, to give a change in color, or structure or both.
t - a significant accumulation of silicate clay.
n - a columnar or prismatic structure, hard consistence when dry and significantly high exchangeable sodium.
f - a significant accumulation of Fe + Al combined with organic matter.
h - a significant accumulation of illluvial organic matter.
g - a significant expression of gleying.[2]

BC — a horizon transitional to B and C.

C — a horizon comparitively unaffected by soil forming processes, except for:
ca - an accumulation of lime.
sa - an accumulation of water-soluble salts.
g - a significant expression of gleying.[2]
s - denotes the presence of salts, including gypsum ($CaSO_4$).
k - denotes the presence of lime.

R — a consolidated bedrock layer.

W — a layer of water.

NOTE:
The lower case letters shown above in the A, B and C horizons are sometimes combined to express combinations of characteristics. Other lower case letters not listed above are:

b - a buried soil horizon
j - a modifier of suffixes e, f, g, n and t to denote expression of, but failure to meet, the specified limits of the suffix it modifies.
u - horizon markedly disrupted by physical or faunal processes other than cryoturbation.
y - a horizon affected by cryoturbation.
z - a perennially frozen layer.

[1]Diagram copied from the National Atlas of Canada (Energy, Mines and Resources, 1973).

[2]"Gleying" refers to a soil forming process operating under poor drainage conditions, which results in the reduction of iron and other elements, in gray colors, and mottles.

FIGURE 2. Diagram[1] of a soil profile and definitions of soil horizon symbols (Canada Soil Survey Committee, 1978).

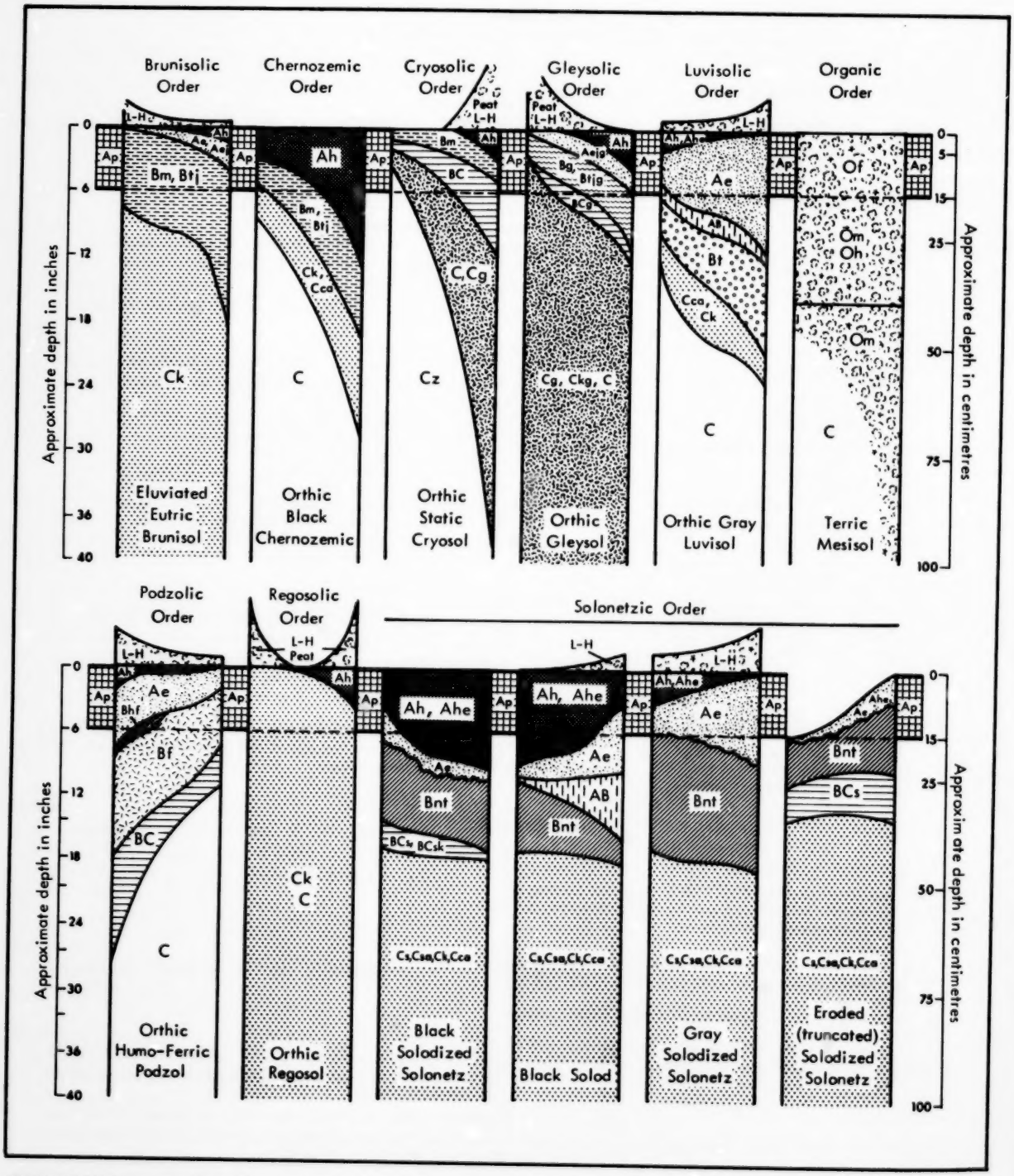


FIGURE 3. Diagrammatic horizon patterns of some representative soil profiles (Canadian Department of Agriculture, 1974).